MOBILIZABLE FORTIFICATIONS

JOSEPH L. BRENT

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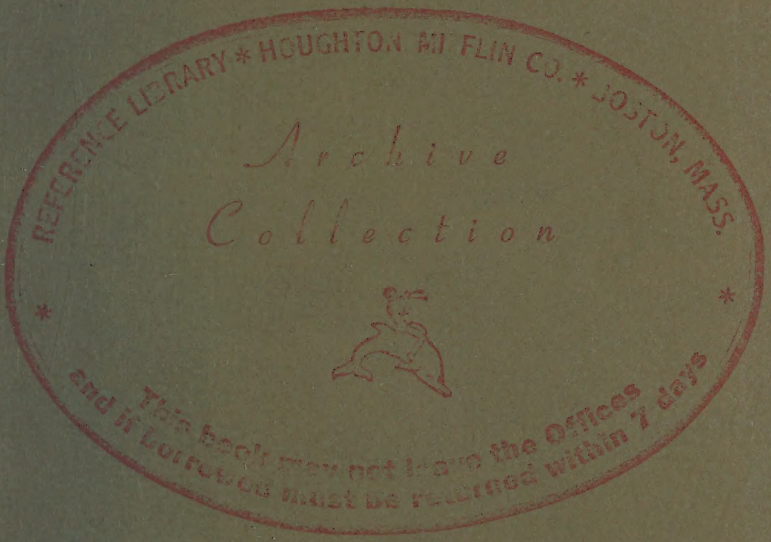
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MOBILIZABLE FORTIFICATIONS, AND THEIR CONTROLLING INFLUENCE IN WAR.

BY

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PREFACE.

I HAVE sought in the following Treatise to consider how one may best defend his country at the least cost of blood and treasure.

The desire to be secure in life and property was the original germ of society first operating in the family, then in the tribe and then in the nation. And to-day the love for national security and independence is the controlling influence of the world.

No sacrifice of blood or treasure ought to be denied when the independence of the Fatherland is involved.

Horace has said that it is pleasant and becoming to die for one's country, but I maintain that it is better to rejoice in its nobly-won victory than to die in its vain defense.

The questions that I discuss offer but little interest to our happy Republic, protected by our geographical position from the fear of invasion; but to England and Europe, the true

science of war is the vital problem of the day.

Its solution is sought by the arming of whole nations at the cost of three fourths of the national resources.

If there be aught of truth in my theory, its adoption will tend to protect the weak, to curb the strong, to lighten the burdens of impoverished millions, and to give to patriotism irresistible resources of defense against attack.

JOSEPH L. BRENT.

ASHLAND, NEW RIVER, LOUISIANA,
September, 1885.

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MOBILIZABLE FORTIFICATIONS.

CHAPTER I.

THE PRESENT SYSTEM OF WAR.

John Bright recently declared that the resources of the nations of Europe were being "swallowed up by the insatiable exigencies of the militarism in which they live." Last year the armies and navies of Europe cost the enormous sum of $917,599,985, while the national debts absorbed the sum of $1,036,159,075 for interest alone, the aggregate national debts reaching the almost inconceivable amount of $23,011,949,705.

SECTION 1. The apprehension of disastrous war is destroying the resources and undermining the governments of the civilized world.

European Christendom has converted itself into an armed camp. Agriculture, commerce, the arts, religion, and human life itself, seem simply to be regarded as instruments to be utilized in the development of military and naval resources.

A great fear is in the heart of every European nation that some powerful neighbor may suddenly spring upon and throttle it.

It is an accepted axiom, among the great powers, that no right is secure unless it is ready to be successfully defended by war. Therefore two and a half millions of men, complete in arms and discipline, and ready, by day or night,

maintain the present European *modus vivendi;* while six and a half millions more of furloughed but drilled men, held by the military law, stand ready to join their colors whenever summoned.

A remorseless conscription diverts from peaceful pursuits and devotes to military service the flower of the human race.

Napoleon formalized the idea of modern war in his famous saying that Providence is always on the side of the "*gros bataillons;*" Leipsic, Waterloo, and Paris twice captured, proved that even he, the greatest captain who ever marshaled the ranks of war, could not escape the influence of the rule which he ascribed to Providence.

It is because this is accepted as an axiom that Europe is being crushed under the weight of armaments; that the burdens of the people grow heavier, while millions fly from their homes to escape them; that morals are deteriorated; that science and the arts are not encouraged as they should be; that the Socialist and Nihilist, offspring of taxation and conscription and resulting poverty, array their millions against the Christian God and Christian society; and that the moral foundations upon which rest alike thrones and republics are being slowly but surely undermined.

SECT. 2. That mere numbers should win battles is a barbaric idea, which governed the world in the time of Semiramis and Nimrod;

and civilization, in demonstrating that it is now true, completes the cycle, and returns to the starting point of human society.

It is an accursed fact, if true, that national existence, that all the thousand ties, associations, rights, and property, that develop in and cluster around the freedom of a people, are dependent on the ability to defend them with a number of trained soldiers greater than can be brought to attack them.

It seems like challenging the justice of Providence to assert that there is no protection for human rights except numbers and discipline of soldiers.

To assert this is to ignore all the achievements of the wonderful human brain, that has developed, and that governs, so many potent agencies of nature now tributary to man.

SECT. 3. I believe that, under the blessings of Providence, civilization, in its progress, has developed powers and agencies that will enable it to successfully defend itself from attack, without regard to the numbers in which the attack may be made.

It may be that in this there is an error, but it is a duty incumbent on all the human race to seek to develop and utilize any idea that may even tend towards the emancipation of our suffering brethren from the countless woes that flow from the huge and treasure-consuming armaments of the present day. However great

may be my errors, still I may drop some hint, suggest some fact, which falling in the richer soil of greater ability and experience may develop into something tending to the benefit of suffering humanity.

SECT. 4. The fundamental truth towards which I struggle is contained in the proposition that, in view of the discoveries of the present age and their just and proper development, the numbers and discipline of troops ought not to be, and are not necessarily, the controlling elements in defensive war.

When savages and barbarians fight, mere numbers are decisive; but when men advance beyond the barbaric state, skill and armament become controlling factors, and numbers have no decisive influence. Thus ten thousand Greeks at Marathon defeated five hundred thousand Persians and Medes; and the Macedonian phalanx and the Roman legion overran the historic world, defeating over and again barbarian armies outnumbering them twenty, thirty, and fifty to one.

Thus Cortez and Pizarro, Clive and Hastings, triumphed against odds, and valiant ones, of fifty, seventy, and one hundred to one.

SECT. 5. It is evident, from these and many other examples, that numbers alone are an insignificant factor in battles when opposed by superior skill, armament, or discipline; but no one can deny that under like conditions of skill,

armament, and discipline, battles are now decided by numbers.

But what are like conditions? The army that attacks and the army that defends a position cannot fight under like conditions. A natural or a fortified position may aid or injure one or the other. The army that fights under a Napoleon or Von Moltke fights under different conditions from the army commanded by an Alvinzi or a Benedek.

CHAPTER II.

THE RESOURCES OF AGGRESSIVE WAR.

SECT. 6. 1st. Is it practicable to devise a system of defense by which nations overthrown in pitched battles, like Austria in 1866, or France in 1870, or nations too weak to deliver battle against a great power, may be able to save their political existence from a total dependence on the will and pleasure of the conqueror?

2d. Are the resources of defensive war capable of being so developed that even small states like Belgium, Holland, or Denmark, or nations like Great Britain or America maintaining only small regular armies, may become able to defeat an invasion, irrespective of the numbers or discipline of the invaders?

SECT. 7. A defensive system necessarily must be equal to the power of attack, and a true consideration of the former requires a careful examination of the resources of aggressive war, by which we can more justly judge the power needed to overcome it.

SECT. 8. Experience proves that in the actual present, pitched battles irretrievably determine

the fate of war; and that fortified cities and places are incompetent, after defeat in the open field, to change or even modify the result.

Previous to the nineteenth century this was not an invariable rule. The comparatively less numerous armies, the bad roads, the scarcity of provisions, and the holding power of fortified places against rude methods of attack, prevented the victor in a pitched battle from reaping decisive success. Thus Hannibal, though he ravaged Italy, could not conquer it, and when he won the great victory of Cannæ dared not undertake the siege of the fortified city of Rome.

The Thirty Years' War was fought out without any decisive results, because defensive was relatively stronger than aggressive war. The same can be said of the wars of the Great Frederic and of the Spanish Succession.

The reason of this is evident. No country then exhausted itself to maintain regular troops; and when one army was defeated, another could be recruited before the triumphant army could reduce the fortified cities. The difficulties of transport over bad roads were insuperable, and rendered it almost an impossibility to overrun and conquer an entire people.

After Agincourt, in 1415, France was reduced to a greater stress than in 1870. The English overran the whole kingdom, occupied Paris and the principal cities; yet the diffi-

culty of concentrating troops on threatened points, of communicating information or collecting provisions, put the invaders at disadvantage as soon as the French seriously undertook to oppose them.

How different it would have been if the English had then possessed the modern agencies of steam and electricity which the Germans used so ably and energetically in 1870!

SECT. 9. Neither the disasters of Blenheim in 1704, nor Ramillies in 1706, nor Malplaquet in 1709, prostrated Louis XIV.; for the war of the succession was only closed in 1713 by the peace of Utrecht.

Neither the terrible defeat of the Great Frederic at Kolin, nor his marvellous and brilliant victories at Rossbach and Leuthen, in 1757, nor the capture of Berlin in 1760, was sufficient to bring the Seven Years' War to a close until after the lapse of several years.

SECT. 10. Nor were results more decisive obtained in the first years of the great French Revolution. Many battles were fought and lost; yet no decisive results followed, until military science attained a greater development under Napoleon, who was eminent as a combatant, but was greater as an organizer and administrator. He it was who organized vast armies, and so equipped and handled them that when once victory was attained it was pushed to decisive results. Thus Austerlitz, fought

December 2, 1805, led to the treaty of Pressburg in thirty days thereafter; Jena and Auerstadt, fought in October, 1806, resulted in the immediate occupation of Berlin and nearly all of Prussia, and the prostration of the kingdom, which would have led to immediate peace but for the support of the Czar of Russia; who, however, was compelled at Tilsit, eight months after, to recognize the conquest and results practically achieved previously.

But still Napoleon, so great a master of war in all its branches, could not always achieve decisive results. Invasions prosecuted at enormous distances from France, in countries sparsely settled, where roads were bad and provisions scarce, became fruitless, and great victories failed to bring decisive results.

But if that great leader had possessed steam and iron roads and telegraphs, there is but little question that the Spanish and Russian disasters that broke him down would have had far different results.

Sect. 11. In considering the enormous results that flow from victory in great battles, reference is only had to the highly civilized countries, where the railway and telegraph systems have obtained considerable development; and in fact the arguments advanced and the conclusions sought to be reached must be understood as addressed to the system of war as waged in civilized countries.

SECT. 12. The greater development of the powers of aggressive war in the present age, and the increased relative weakness of the defensive in modern times, are well illustrated by the American Civil War.

The Confederate States were peopled by eight millions of whites, from whom alone soldiers could be recruited. They occupied a rich country more extensive than France, and entered into the war of secession not only with enthusiasm, but with that steady dogged resolution that is the characteristic of their English ancestry.

There is no other instance in history where a people exhibiting the spirit of the Confederates, and possessing their resources and numbers, have been so thoroughly overcome. The fight they made was not unworthy of the Anglo-Saxon and Celtic races from which they were principally descended.

It cost the Union as much as the national debt of Great Britain, and four hundred thousand lives, to subdue them.

To be sure the work was thoroughly done. Vast armies marched a thousand miles inland. Swarms of cavalry and mounted infantry raided over every section, and when the war was finished there were not enough provisions left in the Confederacy to have fed its armies and people four months. Fortunately the war ended in the spring, and in ninety days after

the surrender of Appomattox roasting ears of Indian corn could be eaten.

What was the cause of this complete triumph and complete conquest?

In the American Revolution in 1775–1782 the English armies marched throughout the country, and yet it was not subdued. Steam and electricity afford the explanation. General Sherman penetrated more than one thousand miles from the Ohio River, south and inland, and though the retreating Confederates destroyed the railroads as they fell back, yet each night, with rare exceptions, saw his supply train reach him, until at Atlanta he cut loose from his base, and marched to the sea through a section of country where there was no army to oppose him. It is evident that without a railroad and telegraphs he would not have advanced even one hundred miles south of the Cumberland River without the greatest difficulty.

The whole area of the South is penetrated by numerous navigable rivers and streams, which together with their confluents and the open ports of the seaboard enabled vessels of war to exercise a great and controlling influence.

SECT. 13. Owing to their greater skill and manufacturing resources, the North built iron-clad gunboats against which it was utterly vain for the South to contend. These gunboats, built of small size and draft penetrated

creeks and bayous whenever a draft of a few feet of water could be found. Protected by iron armor, and armed with one or more heavy guns, they controlled all the conditions of war within the range of their fire.

Wherever a navigable river, creek, or bayou flowed, the Confederate armies were unable to cross if a Federal gunboat were on it. How often has a force of ten thousand men, well equipped with field artillery, been checked and paralyzed by its inability to cross a small stream held by a Federal ironclad upon which there were perhaps only fifty men!

In a struggle like this, numbers were insignificant: a gunboat with fifty men on it dominated the field of war within range of its guns and its movements.

In the alluvial districts of the South, notably in Louisiana, the rivers and bayous run upon a ridge, and the level of the land, unbroken by hills, declines backward from either bank of the stream; hence an iron-clad gunboat was higher than the adjacent country, and its guns absolutely controlled both sides of the river.

Masses of troops were unable to come on either side of such rivers or bayous within range of the hostile artillery, which were generally heavy 9-, 11-, or 15-inch smooth-bore guns. When an ironclad would, as it often chanced, come upon such a stream by surprise,

the troops camped near it would be compelled to abandon their camps in great confusion, and to retreat inland beyond the range of its guns.

Nothing could oppose these iron-clad gunboats except boats like them. Projectiles of field artillery rebounded from their sides, and finally, in the country infested by them, orders were issued to the Confederate field-batteries not to waste ammunition by firing on them.

Accompanying these armored gunboats of the Union government were a class of gunboats protected only with thin iron, sufficient to turn the projectile of small arms, but not to resist artillery fire. These gunboats, generally called *tinclads* on account of their weak armor, were easily captured by field artillery at close range, but could not be taken by infantry alone.

It was by utilizing steam and iron that the Federals were able to penetrate into every corner of the Southern States, while telegraphs kept up a perfect communication over the vast area of the country in which they campaigned.

These causes, intensified by a vigorous and complete blockade of the sea-coast, resulted in the most thorough and complete triumph of the Union arms.

It is hazarding little to say that if steam had not been invented and utilized the result would have been very doubtful.

In addition to these agencies, the skill and

resources of the North organized vast armies, and at the close of the war the Federals had over a million of soldiers under arms.

Sect. 14. But it was in the Franco-German war in 1870 that occurred the most striking illustration of the enormous resources of aggressive modern war.

"In seventeen days after the declaration of war the Germans had four hundred and fifty thousand men concentrated on the French frontier between Trèves and Landau; one hundred thousand additional were being concentrated in the interior ready to be brought forward; four hundred thousand landwehr and reserves remained available at home. Thus, in seventeen days, nine hundred and fifty thousand soldiers were mobilized, one half in the first line, ready for instant battle, and the remainder conveniently held to reinforce the first line." [Blumé.]

Sect. 15. The mind can scarcely grasp the magnitude of an army of four hundred and fifty thousand men, such as the Germans held in hand.

It would have formed a line of battle, with proper reserves, extending across England from the Wash to the Mersey.

It could have delivered battle on any point along a line of one hundred miles; and by means of the telegraph, the will of the commander-in-chief was operative immediately along the whole line.

The world, since its creation, has never seen

so formidable an array; formidable, not for numbers, great as they were, for many barbarian armies have been more numerous, but formidable for numbers, discipline, and armament.

The French, inferior in number, fought fractions against masses, and were defeated wherever encountered.

"In four weeks eight great battles had been fought and won; one of the French armies shut up in Metz, its physical and moral strength shattered by the bloody struggles it had gone through; the other led captive into Germany. Only the Thirteenth Corps had escaped the catastrophe by not arriving in time. An enormous amount of warlike stores had been taken, the road to Paris lay open, the emperor had yielded himself a prisoner." [Blumé.]

In twenty-eight days the physical power of France was broken.

"The war might be looked upon as decided if not concluded." [Blumé.]

Sect. 16. It was in vain that France undertook to reverse the results of these great pitched battles. The superiority of aggressive war after victory was incontestable; and, according to the actual system, no resource existed for the defeated but capitulation or a vain and useless struggle.

Fortified places and cities at one time were able to check the onward march of victory and give a rallying time to the invaded, but war

was then feeble and puny in comparison to its present gigantic strength and capacity.

Austria, wise in defeat, realizing after Sadowa that nothing could resist the army that conquered there, surrendered at once, and saved its people from the bitter trials of invasion and actual physical conquest; but France, unable to realize the changed conditions of aggressive war owing to steam, iron, and electricity, bravely continued a vain and disastrous struggle.

CHAPTER III.

THE PRESENT CIRCULAR OR CLOSED SYSTEM OF FORTIFICATION IS INCAPABLE OF REALIZING THE OBJECTS FOR WHICH IT WAS DEVISED.

SECT. 17. Within the last hundred years fortifications have been gradually losing their ability to hold an enemy in check. Here and there exist examples of a successful defense, but the general tendency of the experience of actual war has been to demonstrate more and more clearly that fortified cities or other closed works have lost their power to influence the fortunes of war. No reference is intended to those special fortifications intended to cover a road or a pass so that an army cannot advance without possessing them, or to forts for the protection of ports, etc.; but allusion is made to places fortified for their own individual defense, such as Metz, Paris, Mayence, Strasburg, and London (if it should ever be fortified), and places of a similar class. While illustrations in large numbers can be found to maintain this view, I will confine myself principally to the lessons derived from French history.

France has been for one hundred years the best fortified country in the world, and talent and wealth have been lavished in fortifying especially her northern and eastern frontiers and Paris.

What advantage in this century has she ever derived from them? Twice, in the early part of the century, has she been invaded and Paris captured. In the able and brilliant defense made by Napoleon against the first invasion, what single substantial advantage did he derive from fortified cities or places?

It is not intended to say that there were not some advantages realized, but it is maintained that they were inconsiderable, and had no appreciable influence upon the result of the campaign; and to produce this partial effect would not repay the cost in men and material to garrison them.

It was resolved by Louis Philippe and his government to secure Paris from the possibility of a third capture. It was fortified at an expense of twenty-five million dollars. Its *enceinte* was over twenty miles in circumference, and its sixteen detached forts formed an exterior circle over thirty-four miles around. In order to invest Paris, a besieging enemy was compelled to hold a circle the circumference of which was over fifty miles. Metz had been much strengthened in modern times, and had become a fortress utterly impregnable to direct

attack; and a besieging enemy was compelled to hold a circle of investment having a circumference of twenty-three miles.

After the victories won by the Germans in 1870, in the open field, both of these fortified cities succumbed.

SECT. 18. It is not only intended to say that the present closed and circular system of fortification is defective and feeble, in view of the augmented power of attack arising from improved armament and more efficient and thorough military organization; but the theory sought to be demonstrated goes to the extent of pronouncing the prevalent system obsolete, and a positive injury to the party attempting to utilize it, except in the isolated cases of places fortified to cover a pass or a military depot, or to protect sea-coast cities or harbors and the like.

It may be admitted that a fortified place can be made too strong to be assaulted, like Paris, Metz, and Belfort, and that the enemy must use time to reduce them by regular approaches or by famine; but it does not follow that this is an advantage to the invaded country.

To protract the struggle without changing the result is not advantageous; and if the besieger loses time he is repaid for it, while the besieged loses all.

"*Place assiégée, place prise,*" has grown into an accepted proverb; hence it pays the be-

sieger to wait for his certain triumph, and the besieged is sure to lose.

The system is prejudicial in this: that the fate of the war is to be decided in the open field, and that the strength of the invaded country is frittered away by providing garrisons and materials which are lacking on the field in the hour of decisive combat. The invader moves on, bringing his whole combatant force with him; and he encounters the main body of the defending army, diminished in the supreme moment of battle by the necessity of providing well-appointed garrisons for fortified places, certain to be captured if the battle be lost, and certain to escape siege if the battle be won.

Sect. 19. If in 1866 Austria had sent the garrisons of the Quadrilateral of Lombardy to join Benedek at Sadowa, holding in Italy only sufficient force to check the Italians in open field, the garrisons so sent might have had some influence upon the decision of the war. If Sadowa had been won, Lombardy would be safe; but the victory of Custozza could not save the Quadrilateral, when Sadowa was lost.

It is beyond peradventure evident that if Mantua, Verona, Peschiera and Legnago had been dismantled fortresses in 1866, the Austrian power would have been augmented by the presence of additional troops at the decisive point; and thus at least the chances of success

would have been greater, whatever the result might have been.

SECT. 20. Whenever a fortified place is held to be of such importance that the manœuvres of the army in the field are subordinate to its protection, the germ of a great disaster is created.

In the Civil War in America, the Confederates made the defense of the city of Vicksburg a controlling object, and the result was a great disaster when their army was driven behind the fortifications after the defeat in the open field.

After the battle of Big Black, the main body of the Confederates fell back to the intrenched lines at Vicksburg; but one of its divisions, Loring's, was unable or wisely unwilling to reach them, and retreated to the interior. Vicksburg was invested and captured, and the Confederates lost twenty-seven thousand men made prisoners, and vast *matériel.*

Loring's division, which escaped after the defeat, was saved to the Confederates, and rendered good and efficient service in the after campaigns.

No such disaster ever befell the Confederates in the open field. If twenty-seven thousand men be lost in a pitched battle, they generally cost the enemy very nearly as much, and thus his power is reduced even after victory; but when so many are captured by siege, the in-

vesting enemy rarely suffers much loss; hence his power becomes proportionately greater as his victory is purchased without diminishing his strength.

When General Grant, in 1864, opened his campaign against General Lee in Virginia, the Union army, composed of four corps with cavalry, amounted to 140,000 men; while the force opposed to it under the Confederate leader was 56,626 men — foot, horse, and artillery.

So long as General Lee manœuvred in the open country, distant from Richmond and Petersburg, his defense was energetic and successful, equaling in results any defensive campaign, under conditions of similar inequality of forces, of which history has made a record.

But when General Grant, wisely crossing the James River, threatened Petersburg and Richmond, all of General Lee's plans were subordinated to the necessity of defending these two places; and though the defense was brilliant, defeat was attended with the loss of his army and the Confederate cause.

The lesson taught by this instructive campaign is that if General Lee had not been tied to the defense of Richmond he could have fallen back to the interior, and protracted the campaign until his supplies were exhausted.

SECT. 21. The defeat of France in 1870 teaches the same lesson. The city of Strasburg was strongly fortified and garrisoned.

The large armies of the present day can readily spare a detachment sufficiently strong to observe fortresses without diminishing materially their combatant numbers; and raw levies can besiege and invest almost as effectively as better-disciplined troops.

This occurred in the siege of Strasburg, which was invested by the Baden division, being the only regular troops, aided by the first reserve and the first landwehr divisions. In other words, the Germans converted the siege into a camp of instruction for the reserves. The town surrendered on the thirty-fourth day after fire was opened on it; the garrison, composed of 450 officers and 17,000 men, became prisoners of war, and 1,200 guns and valuable stores were captured. What an enormous loss! 17,000 troops! This exceeded the French loss at Weissemburg, Wörth, and Spicheren, combined; it exceeded Bazaine's loss at Gravelotte or Mars-la-Tour.

Let us examine and see if a corresponding injury were inflicted on the Germans.

The French killed 80 Germans, and lost, of citizens, 480 killed and 2,000 wounded; and of soldiers killed and wounded, 45 officers and 750 men!

SECT. 22. After the defeats at Spicheren and Wörth, the French emperor determined to fall back to Chalons, and unite his defeated right and left with such troops as could be con-

centrated there. The wisdom of this course is undeniable; but the existence of the fortified city of Metz prevented the execution of this plan.

How can it be denied that if Bazaine had not felt the fatal influence of Metz, he would not have tarried there from the 6th of August, the date of the double defeat of Spicheren and Wörth, until the 16th, or that he would have allowed the affair of his rear guard at Courcelles on the 14th to have delayed him until the Germans reached his line of retreat at Gravelotte and Mars-la-Tour?

If Metz had been an open city, Bazaine would have resolutely marched through it, passing by Mars-la-Tour, and reaching Verdun before the Germans could have crossed the Moselle, thus easily leading his fine army, the bulwark of France, to a junction with McMahon at Chalons. He thus lost his army completely and totally.

If he had been defeated in the open field, still France would have saved the greater part of his routed army, ready to form a nucleus for further defense under the walls of Paris; but once shut up in Metz, everything was lost.

After resisting the investment for seventy days, Bazaine surrendered one hundred and seventy thousand men, including sick and wounded, together with Metz and countless stores and equipments.

The Germans achieved this success by the loss of 2,279 soldiers, either killed in action or died in hospital.

If Bazaine had succumbed in the open field, the loss of the Germans would have diminished their strength; but Prince Frederic Charles led away from captured Metz his army in undiminished numbers and increased *morale* and discipline.

At Mars-la-Tour the Germans lost 14,820 men, put *hors de combat,* and at Gravelotte, 20,527, — over 35,000 in three days combat; and the French army, fighting in the open field with the odds of one to two, lost but 32,764, and, shaken somewhat in *morale,* remained intact and powerful as an organized body, sufficient, doubtless, after a junction with McMahon, to have prevented the investment of Paris and to have obtained better terms of peace for France, even though it might not have been able to wring victory from its formidable and victorious adversary.

This magnificent army was totally lost and obliterated, because it yielded to the seductive influence and the deceitful security of one of the most powerful fortified cities of the world; and its enemy purchased his astounding and unparalleled success with a trivial and insignificant loss.

It may be said that the French did not properly use, but rather abused the fortification of

Metz; but there must be something radically defective in the use of fortifications, under the present system of war, which leads to such a disaster.

Sect. 23. Nor is the surrender and loss of Bazaine's army the only disaster to be imputed to what can justly be called the seductive influence of fortified places.

When the intelligence that Bazaine had been shut up in Metz reached Chalons, the Emperor Napoleon and Marshal McMahon found under their command the newly formed Twelfth Army Corps and the Thirteenth Army Corps in process of organization, the débris of Failly's and McMahon's corps, and the Garde Mobile.

This force, if removed to Paris, reorganized and reënforced, would have served as the nucleus of a new army, which, mixed with seasoned troops and led by skillful officers, might reasonably be expected to have put some check upon the German advance until France should have had the opportunity to make a supreme effort to protect herself by a *levée en masse.*

It is well known that the Emperor Napoleon, exhibiting in misfortune a clearness and precision of judgment worthy of his race, urged and supported the policy of ignoring the existence of Metz and the army it held, and of retreating under the walls of Paris, and there preparing for a struggle which would find him stronger and the invader weaker.

It is also known that Marshal McMahon, upon whom devolved the responsible command of the French army, according to the abnormal and confused organization which led to the partial abdication of the emperor before Sedan, shared the views of the unfortunate Napoleon, but felt constrained, from the appeal of Bazaine and the pressure of Count Palikao, the war minister of the regency, and against his own judgment, to fall into the error of subordinating the struggle of the great campaign to the effort to release Bazaine's army from Metz, and in the vain effort lost his own army at Sedan.

It results, then, that both armies owed their destruction to the disturbing influence of the fatal fortifications of Metz.

SECT. 24. If closed fortifications be able to resist modern attack, this fact would have been demonstrated in France in 1870. What are the facts?

Thionville surrendered after three days' bombardment. Toul, a most important fortress, and one which, under any system of defense, should be fortified, as it commanded the only railroad which, in the early part of the siege of Paris, could be opened to the Germans, capitulated in a few days after siege guns opened upon it. Montmédy, Mézières, Schillstadt, Amiens, all fell without difficulty. The Germans took the heavy guns captured in the citadel of Amiens and bombarded Péronne until its surrender.

The Germans captured twenty-two fortified cities and places, with 5,373 garrison guns and vast stores. These were captured with but trivial loss, and their defense had no appreciable influence on the war.

SECT. 25. It may be said that Belfort was never captured, and that the defense of Paris was beneficial.

It is true that Belfort was not captured, but it could have held out only a few days longer if peace had not arrested the siege.

The defense of Belfort was earnest and dogged, and so was the attack. After the first parallel was opened and the garrison had undergone a terrible fire on the night of January 26, 1871, it bloodily repulsed a bold and desperate effort to storm it.

It was in midwinter, a season very unfavorable to attack. On the 31st of January the second parallel was opened, and the difficulties of the siege may be inferred from the necessity of making approaches, with regular sap, in rocky and frozen soil.

However, on the 7th of February, the glacis was crowned, and on the 8th was taken after a feeble resistance.

A few days after, the treaty of Paris ended hostilities; and on February 18th Belfort was occupied by the Germans.

It is evident that powerful as was the fortress it was unable to do more than protract a vain defense.

But was the defense of Belfort beneficial to France? A garrison of sixteen thousand men was absolutely lost after its investment, and while it is true the enemy was induced to occupy nearly as many men in the investment, yet the besieging force, being free, exercised influence over an extensive area of country. Belfort was invested October 3, 1870, by General Van Treskow with the First Reserve Division, a force not materially outnumbering the invested garrison.

In January, the same course of reasoning that had led McMahon towards the fortifications of Metz repeated itself in the French councils, and with the same disastrous effects. It was decided that Bourbaki should separate his strong army from the Second Army of the Loire and should march to Belfort with the object of raising the siege; and in this effort he lost an army more numerous than McMahon's: an army which, if it had been in supporting distance of Chanzy, when Prince Frederic Charles routed him at Le Mans, might have exerted a most important influence on the campaign.

It would have been far better for France if Belfort had long previously surrendered than to have so fatally influenced her fortunes. While the French garrison, after investment, exercised no beneficial influence upon the war, the investing force of the Germans was able to exercise a decisive and direct influence.

Von Werder, the German commander, concentrated his force, inferior in number, at Montbéliard, just in front of Belfort, and there encountered Bourbaki's army. There was fought the battle that determined the campaign; and in this decisive struggle the guns of the investing force and a strong detachment from it took an important part; while the French garrison, hemmed in by the first parallel of the Germans, was compelled to look on, a passive spectator of a combat pregnant with its fate, but in which it struck no blow. If the account showing whether Belfort benefited or injured France be stated, upon which side will the balance appear?

SECT. 26. It may be argued, however, that the defense of Paris, in conjunction with the defense of Metz, Belfort, and other fortified towns, was beneficial in this: that the Germans were compelled to devote the bulk of their forces to sieges, and were prevented from overrunning an open country; and that, thereby, time was given for the organization of the seven hundred thousand men assembled by the active and energetic Gambetta.

Was this really an advantage to France? When the armies of McMahon and Bazaine were lost, what well-formed hope existed of obtaining success?

A country should be governed wisely, and it cannot be the part of wisdom to continue a hopeless contest.

If peace had been made after Sedan, and even the same terms imposed (which is scarcely probable) that were accepted five months after, how beneficial such a course would have been to France! Austria did this after Sadowa, and no one has ever supposed that she acted unwisely or dishonorably. It is the part of a brave people to accept with dignity the inevitable. If the purpose of war be to gain, then all the blood that was shed after Sedan was uselessly shed; all the treasure expended, merely squandered. The war continued for five months on French soil, which supported both armies; and each day the triumph of the Germans was more conspicuous, and each day France suffered more, and all the pangs and agonies endured had no more influence on the result than an eclipse of a satellite of Jupiter.

It is no disgrace for a soldier, that noblest embodiment of our physical virtues, to retreat before a victorious foe. He accepts the inevitable and goes back before the advancing line of battle because it cannot be resisted; and yet he knows that his retreat is national disaster. Why should not the nation do the same? Look at Austria, and look at France, and answer!

It is comprehensible that a man or a nation may prefer death to surrender. This is heroic and noble; and history abounds with such examples, and human nature is ennobled by them.

The Spartan soldier was to die, not to retreat or surrender.

But this was pagan, not Christian law; and it has never been acted on, except when it was known that a surrender meant death.

SECT. 27. The siege of Paris teaches that the modern system of fortifications is incapable of resisting attack, and that it is a positive injury to the people availing themselves of it, except under certain and definite conditions. Paris was the largest fortification in the world; it was so strong that even the bold and confident German army shrunk from an effort to storm it.

To invest it the Germans held a circle fifty miles in circumference.

The garrison of Paris was composed of four hundred thousand Frenchmen, enrolled as soldiers of the line, and in the Garde Mobile, the Garde Sédentaire, the Garde de Paris, and in naval and special corps.

It was invested on the 19th of September, 1870, by 122,661 infantry and 24,325 cavalry of the German army; but the investing army was afterwards increased, and was maintained at an average of two hundred thousand men.

SECT. 28. Four days before the investment, the king of Prussia issued his order prescribing the details of the investment; and the first condition established was that the investing troops were to strengthen their first line by fortifications out of the range of the guns of

Paris. This was systematically done, so that it resulted, practically, that when the Parisians took the offensive it became incumbent on them to assail fortifications; with this difference, however, that the German forces had their communications open, while the Parisians had theirs closed, and that while the Germans had full liberty either to assault or to blockade, the French were either forced to take the local offensive and assault the German intrenched lines, or to be starved into surrender.

As the Germans lived mostly at the expense of France, and did not exceed two hundred thousand men, they could better afford to wait than the Parisians, who had nearly two million mouths to feed from stores that could not be replenished.

SECT. 29. Nor were the fortifications of Paris capable of saving the city, for it fell; nor were they even sufficient to save it from destruction, though they were so large.

The long-range guns of the Germans easily reached important and crowded portions of the great city. After the German siege batteries were in position, they were only used against the city for twenty-two days, and then not continuously, as they were often directed against the detached forts.

There is no city in the world more substantially built than Paris, or better calculated to withstand the effects of a bombardment; yet

the effect produced by the partial and interrupted German fire was considerable.

Sarrepont estimates that twelve thousand projectiles fell in the city during the bombardment, that four hundred persons were killed or wounded, fourteen thousand houses struck, and fifty fires started.

The panic-stricken population abandoned the exposed side of the Seine, and crossed over to the other bank; the government seized all the vacant rooms in the sections not under fire, and established the fugitives in them.

The Prussian official account claims that it was intended not to destroy, but to demoralize Paris. It is certain that the German guns were able to throw over four thousand projectiles in twenty-four hours, if they had been so disposed; and we may imagine what would have been the panic and destruction if ninety thousand shells instead of twelve thousand had fallen.

This bombardment occurred before the armistice; but when it was concluded the Germans had in position seven hundred siege guns bearing on Paris, and capable with ease of throwing over one hundred thousand shells in twenty-four hours; and it is not difficult to believe that it would have tested the endurance of the heroic Parisians to bear this iron storm during even two or three days.

Sect. 30. Independently of the fact that the

long-range guns of modern days render it difficult to protect fortified cities from a destructive and crushing bombardment, the present system of closed fortifications has become fatally defective, owing to the circumstance that the present improved small arms and artillery increase the holding power of lines to such a degree that the encircled mass, though even greater in numbers, cannot break through them.

This idea may be formalized in the following statement: A mass of troops, in close formation, being surrounded by a line containing a fraction not less in numbers than one half of the surrounded mass, must necessarily succumb or surrender.

If a corps of twenty thousand men should camp in such order that a circle having a circumference of three miles would inclose them, then ten thousand men, occupying the inclosing circle, would necessarily capture or destroy the surrounded corps.

Scherf, in his "Infantry Tactics," says that four thousand seven hundred men constitute a fighting line, its supports, and main body, sufficient to hold a line one mile long; but the Germans invested Paris with four thousand men to the mile.

So soon as the investing circle is formed, it would concentrate by advancing to the centre; and the invested corps, not being able to deploy, and being outflanked and enfiladed to

right and left, should be destroyed. It is useless to say that the corps would break through the thin line of investment, because, as it cannot deploy, it must advance in mass of columns, which would be met in front by an equal line of fire, and would be enfiladed on its right, left, and rear; and under such conditions would be powerless. The rapid fire of breech-loaders, machine and field guns enhances the holding power of a thin encircling line to such a degree that a column of attack assailed on both flanks and rear must perish.

SECT. 31. If this be possible in the open field, it is inevitable when an inclosed fort or city permits an investing force to fortify itself.

These conclusions are justified by actual results in late wars.

The garrisons of Metz, Paris, and Plevna were unable to break through investing lines; and the army at Sedan was forced to surrender or to undergo total destruction.

The process by which these results are produced is simple. An investing line holds a circle larger than the invested force; hence the investers have a longer line of fire which converges inward, while the invested necessarily display a shorter line of fire which diverges outward. If the inner line attack, it is enveloped on both flanks, or, if the force holding the inner circle form columns of attack, it must be destroyed, if the enveloping force be armed with improved breech-loaders.

These are primary and simple principles that will prove themselves, when tested by experience, on a small or a large scale, behind intrenched positions or in the open field.

Both Bazaine in Metz and Trochu in Paris demonstrate their truth. Both sallied from the inner circle and attacked the investing line; and both failed, suffering double the losses they inflicted, as must necessarily have been the case.

SECT. 32. Around Paris the circle of investment was fifty miles in circumference, and was most generally held by two hundred thousand men, or four thousand to a mile. Within the invested circle of thirty-four miles in circumference were four hundred thousand men in the various military organizations; but nearly one half of them were soldiers of the line, of the Garde Mobile, and marines. The French undertook to break the thin investing line by hurling masses of troops upon it at selected points; and the great extent of the line offered most favorable conditions. Ducrot's sorties in November and December were formidable and courageous attacks, necessarily failing, in accordance with the foregoing reasoning, and yet illustrating it not only by their failure, but by the fact that they imposed a loss of twelve thousand men on the troops emerging from the smaller circle against six thousand on the troops holding the defensive on the larger circle.

The last sortie from Paris was made in front of Mont-Valérien, and was repulsed by the Germans, holding strong positions and suffering a loss of only seven hundred, while the French lost six thousand.

Sect. 33. Such attacks in columns as McDonald's and Ney's belong to the past, not to the present. Then smooth-bore flint-lock muskets, effective at short range, made these attacks destructive and difficult; while now, breech-loaders, deadly at a distance of two thousand yards, render them impossible. Even as late as Solferino, the French charged in lines of battalion columns and succeeded; but at Mars-la-Tour a similar formation was utterly shattered before it came near the position to be attacked, just as the Austrians had failed in 1866 against the same needle-guns.

But the crowning failure overtook that magnificent body of troops, the Prussian Guard, who, possibly in contempt of the French as well as of their own experience with the Austrians, undertook in battalion columns to storm Montagne St. Privat, but who in ten minutes lost six thousand men under the fire of Canrobert's corps, at one thousand to fifteen hundred yards distance.

The lesson of this terrible result was formalized in the instructions and directions contained in the famous order of the king of Prussia, issued immediately after.

Sect. 34. Illustrations and incidents might be further given to establish the principles as laid down above, especially from the Civil War in America, where the Confederate General Lee first began, in 1864, to strengthen his skirmish line until it fulfilled all the conditions of the fighting line as afterwards adopted in Europe; but enough has been stated to show that experience is in harmony with theory.

Sect. 35. The conclusions to be drawn from the foregoing discussion of the powers of aggressive war may be embodied in the following corollaries: —

1st. That a victory in the open field is decisive of war, as waged at present, in civilized countries.

2d. That the present system of fortification is inadequate to accomplish the purpose for which it was designed; and that it should be abandoned, with certain definite exceptions.

CHAPTER IV.

A NEW SYSTEM OF DEFENSIVE WAR BASED ON MOBILIZABLE FORTIFICATIONS

SECT. 36. THERE is but little expectation that the views herein suggested will meet favorable consideration at an early date, but they have been elaborated with the hope that, as they are the result of some little experience and of much observation and study, they may serve as hints or finger-posts to point out the direction in which, possibly, may be found something tending to emancipate the human race from the heavy burdens and exactions of the present military systems.

There is no further development to be sought in the perfection of weapons. Gigantic artillery, improved field artillery, volcanic and machine guns and breech-loading rifles have achieved a perfection in rapidity, precision, and range of fire so complete as to need nothing more to be desired in the way of engines destructive of human life, until, at last, some chemist shall utilize osmic gas or something else more fatal, and thereby proceed to destroy armies, or perhaps nations, in a moment.

Sect. 37. The line of improvement in future wars is to be found in the development of *matériel* and diminution of *personnel*, with a resulting economy in human lives. These views are best illustrated by a reference to the present condition of naval warfare.

There the protection of life and of guns is esteemed a controlling object, while improved and augmented *matériel* is employed with diminished *personnel*.

In the latest model of iron-clad ships, protection is afforded by twenty-two inches of armor, while 80- and 100-ton guns are served by half-a-dozen men; and even larger guns are being designed.

The increase of effective armament, with a diminution of the number of persons required for its service on the one side, keeps pace, in marine war, with the protection of armament and of life on the other side.

Sect. 38. Armament is made more effective by concentrating in one gun the power of the guns of a dozen line-of-battle ships.

In 1802 Great Britain had in commission 833 vessels of all classes. Of these five carried 100 guns and upwards, seventeen from 90 to 98 guns, and 125 from 64 to 84 guns.

These 833 vessels mounted over 22,000 guns, and but few, if any, of these were larger than 32-pounders. As late as 1859 the 68-pound guns were esteemed a most formidable armament.

Contrast a single ironclad of the present British navy with its former wooden fleet.

It is within bounds to say that any one of fifteen or twenty ironclads of its present navy, each manned by less than 400 men, could, without the loss of a single man, have destroyed the whole 833 vessels of the navy of 1802 with their 22,000 guns, and the 60,000 men that manned them.

SECT. 39. Consider for a moment the power of the modern fleets, not only of England, but of the world, as they existed twenty years ago. They carried not less than 30,000 guns, not many of which were as heavy as 68-pounders; and they were manned by 100,000 seamen. The cost of a ship rarely exceeded £1,000 per gun, and was often far less. See what modern science has done in changing every condition of naval war! Now there is concentrated in a single armored ship more aggressive and defensive power than the combined navies of the world possessed only twenty years ago.

This result has been obtained by substituting iron and steel for wood, steam for wind, mechanical appliances for human hands, and increased expenditure for *matériel* and the protection of human life.

SECT. 40. We have in the English ship Inflexible the type by which science has demonstrated that its powers, agencies, and resources are so enormous that numbers of men, and

even their courage, are utterly insignificant factors in maritime war, while even more formidable ships are being constructed.

Instead of wood, she is defended by an armor which alone weighs 3,552 tons. Her cost has ascended from £1,000 per gun to £125,000. Her guns have diminished in number from 120 to 4, but the force of the projectiles of her four 80-ton guns exceeds in foot-tons the force of the broadsides of one hundred of the choicest and heaviest line-of-battle ships of the navies of twenty-five years past. To man and fight the guns of a first-class line-of-battle ship required from 1,000 to 1,200 men, while the crew of the Inflexible is less than 500 men, and its four guns can be fought by six men to the gun, or twenty-four gunners in all, and these men fight behind armor three feet thick; that is, in almost absolute security of life and gun.

If she encounter or be attacked by a million of men or one thousand vessels equipped and armed according to the system prevailing twenty-five years ago, the million men and one thousand ships would be easily and completely defeated, while her defenders would be almost beyond danger.

Sect. 41. But as formidable as the Inflexible seems, naval science has devised in the Benbow, now in process of construction, a swifter and more formidable ship.

Instead of the heavy armor of the Inflexible,

the armor-belt of the Benbow is only eighteen inches thick, but it is iron faced with steel; thereby offering a greater resistance to projectiles than twenty-four inches of iron. Instead of 80-ton guns in turrets, the Benbow will carry two 110-ton guns *en barbette*. The sloping bulwarks, over which the guns protrude, are protected by steel and iron armor of fourteen inches thickness, but by reason of the slope judged equal to fifteen and one half inches of thickness. These two guns are to fire projectiles weighing 1,800 pounds, propelled by the explosion of 900 pounds of powder, or one half the weight of the projectile. A single shell contains 1,700 bullets, each weighing half a pound.

These two heavy guns are to be supported by ten 6-inch guns, twelve 6-pounders, ten Nordenfeldt guns, and three Gatlings. Her whole crew, engineers, stokers, and all, will consist of only four hundred and thirty men, and she is expected to steam near twenty miles an hour.

When launched and equipped she will be the Empress of the Seas, until science shall devise some more formidable type.

It is a kindred principle to that adopted for naval war, with necessary modifications, that I would apply to defensive war on land.

THE TRUE THEORY OF DEFENSIVE WAR APPLICABLE TO CIVILIZED COUNTRIES.

SECT. 42. It is believed that the burdens that military organization and armament impose upon humanity can be diminished immeasurably by strengthening the resources of defensive war to such an extent as to make aggressive wars simply impossible.

If this result be achieved, standing armies can be diminished, and the remorseless conscription that embraces all that is most precious of man in Europe, sparing not the minister of God nor the professor nor student, may be materially restricted, if not abolished, in times of peace.

Diminished taxation and increased number of workers in the field and shop will minimize poverty, will restore the human race to a normal and natural life, will cheapen the necessities of existence and promote the general happiness, education, and morality.

Inspired with this hope, I have cultivated the germs of the theory which I advocate, and which found birth on the actual field of war; and for twenty years I have thought upon and studied it. In order to verify my conclusions I have critically passed over twenty thousand miles of railroad; and besides my familiarity with the aspect of my own country, I have vis-

ited many of the battle-fields of Europe, especially in France and Italy, and have sought by study and examination to test my theory by its supposed application upon the scenes of actual war and campaign.

SECT. 43. The inventions of modern science, in allowing the application of steam, iron and electricity, have minimized the capability of numbers of soldiers to decide the results of war, and have developed the fitness and applicability of *matériel* and mechanical agencies to purposes of war to such an extent that such *matériel* and mechanical appliances can develop the holding and defensive power of small bodies of men so that it cannot be overcome by the larger numbers or greater resources of attack.

In other words, I claim that the resources of defensive war are susceptible of such a development as to leave aggressive war too feeble for success, irrespective of numbers of men.

CHAPTER V.

SEVEN PROPOSITIONS.

Sect. 44. The true principles of war never vary, but the application of these principles varies with the weapons and appliances of each age. I therefore claim that the true application of the principles of war is to be found in the system formulated in the following propositions: —

1st. Pitched battles determine the fate of war as now waged; and fortified cities and places are incompetent, after defeat, to change the result.

2d. The present system of works and fortifications enveloping cities and places has been proven by experience to be not strong enough to cope with the increased resources of modern attack, and should, with rare and definite exceptions, be abandoned as obsolete.

3d. Aggressive wars can be successfully resisted by small numbers of troops, holding fortified lines of great length and incapable of being flanked, and so constructed as to impede or restrict the movements of the attacking forces

to such a degree that they are either forced to attack under conditions forbidding any reasonable hopes of success or to abandon the campaign.

4th. The ordinary commercial railways can be converted into strategic lines without flanks, which are capable of being cheaply prepared and fortified in such a manner that small bodies of troops can hold them against attack, irrespective of numbers; and these lines, when so held, control and dominate all the conditions of war.

5th. Armored and unarmored batteries carrying heavy, light, and machine guns, and movable on railway tracks, are capable of being used as fortifications for railways; and when so used are endowed with excessive mobility, enabling concentration on menaced points; and generally command a belt of land on each side equal to the effective range of the guns with which they may be armed; and may be given such invulnerability when armored as to render capture improbable, if not impossible; and when without armour may be defended under conditions that will render capture highly improbable.

6th. An improved system of fortifications applicable to large areas of territory may be developed as follows:

a. By equipping the commercial railways, and such auxiliary roads as the contour of the

country may require, with mobilizable batteries mounted on railway wagons properly armed and prepared to encounter all the conditions of attack, and in sufficient number, having regard to their mobility, to form effective chains of fortifications, so as to embrace the whole district of country to be defended and to have such extension as to present no flank to be turned.

b. When the commercial railways do not offer proper facilities for the effective handling of a sufficient number of batteries and their supplies, or when an exceptional contour of land prevents the command by the batteries on the railway of its adjacent belts of land, by supplementing the deficiency either by the building of salient, segmental, parallel, or junction railways or parts of railways; or by auxiliary works, adapted to the exigencies of the situation; or by constructing bullet-proof wagons armed with machine guns, movable on rails or on ordinary roads, either by road locomotives, horses, men, or other power, and by placing such wagons in suitable prepared or selected positions for the purpose of engaging skirmishers or infantry.

c. By uniting the various railway lines radiating from important cities or centres by junction or belt roads, built at such distances as to keep such cities or centres beyond the range of the heaviest guns, or even beyond investment; by selecting from the radiating railways those running in opposite or other direc-

tions and most easily adapted for conversion into fortified lines; and by arming them with movable batteries and auxiliary works.

For example, Paris would become impregnable by belts of railways connecting its radiating lines in selected circles of twenty, twenty-five, and thirty miles radius, requiring investment lines exceeding the whole circumference of the circling belts; and then by fortifying and arming the railway lines toward Orleans on the south and Amiens on the north, or toward any other direction that may appear to be more suitable, for such distances as to render investment simply impracticable.

The same principles may be applied to London and to all railway centres or crossings of railways, and to two or more parallel lines of railways.

7th. Railway lines armed with suitable batteries can be used for the investment of armies, fortified cities or places, and for the isolation of particular sections of country.

SECT. 45. It cannot be denied that if railways could be equipped and armed so as to dominate the country lying on each side, to the extent of the range of their guns, and so as to forbid the possibility of their being crossed by an enemy, it would be a desirable consummation, revolutionizing the present system of war; but the possibility of arming and defending whole lines of railways will be almost universally denied.

If a railway could be armed and fortified so as to prevent an enemy from crossing it or approaching within the belt on either side commanded by its guns, the belt being six, eight, or twelve miles in width according to the range of the railway guns, then, from the number of railways already existing and the facility of their further construction, every condition of war as at present waged would be controlled or modified.

In order to realize the importance of railways, it is only necessary to look at any railroad map.

Like the veins and arteries of the human body, railways traverse civilized countries.

If by a freak of nature each line of railway should become a broad navigable river six miles wide, every condition of aggressive and defensive war would become modified, and he who controlled these rivers would overcome his enemy, who might be destitute of the power of contesting the dominion of the waters.

But if railways be armed with guns capable of commanding a belt of land three miles wide on each side and protected under conditions and by means that would absolutely prevent capture, then a belt of land six miles wide would be made as difficult to traverse as if the deep waters of a broad river were flowing over it.

SECT. 46. How far could an enemy advance

in France, Italy, Belgium, Holland, England, or the United States of America, if he were unable to march across a railway? In the war of 1870, at Wörth, the French position was just in front of the railway from Strasburg to Bitche; at Spicheren the combat was within the angle formed by two railways, and heavy fighting occurred along the track of the line from Saarbrücken to Forbach.

To reach Gravelotte, the Prussians crossed two lines of railway, the defense of either of which would have impeded the turning movement which shut Bazaine up in Metz.

Paris was invested by marching across its seven radiating trunk lines of railways, the holding of any one of which would have prevented investment.

In England the railways are so numerous that a large army can scarcely find sufficient space for camping without crossing the rails of several roads.

Hence the proposition is not too broadly put when it claims that if railways, with the adjacent belts of land six miles wide, be fortified, they will control all the operations of war.

The vast importance of controlling railways being self-evident, let us examine the obstacles in the way of exercising that control.

THE OBJECTIONS.

SECT. 47. 1st. Is it practicable to use armored and unarmored batteries, mounting effective guns, on rails and within the limited width allowed by the ordinary gauge of railways?

2d. If it be practicable to use such batteries, will they be able to command the belts of land lying on each side, within the effective range of their guns; and will not the hills and ravines approaching them, or the cuts through which they pass, enable an enemy to approach them without exposure to fire and thus surely to cripple or capture them, or to tear up the track and thus isolate them by destroying their mobility and by breaking the continuity of the lines attempted to be held?

3d. Will it not be possible for an enemy strong in numbers and artillery to capture the batteries on the railway, or to surprise or cross some undefended section of the railway track, and then destroy it; or could not the enemy, disregarding the armed railway line, march past it into the interior?

CAN ARTILLERY BE USED ON RAILS WITHIN THE NARROW LIMITS OF THE RAILWAY GAUGE?

SECT. 48. The ordinary railway gauge, averaging about 4.7 feet, more or less, admits at

present of the use of carriages eight feet wide and of any length up to sixty feet, without impairing stability or interfering with similar carriages on the adjoining track. There can be no difficulty in mounting guns on a platform eight feet wide. The turret of the British ironclad Monarch is only twenty-six and one half feet in diameter, and yet it completely houses and encloses two 25-ton guns.

In a railway battery it would not be necessary to house or inclose guns, and, as breech-loaders would be more convenient for use, they could be adopted as the type of the railway gun, with their muzzles protruding over the battery. It is true the English and American military authorities adhere to muzzle-loading artillery; but the whole of Continental Europe has adopted breech-loaders in preference, and this example must be followed. While not disposed to enter upon the discussion of the relative advantage of the two styles of guns, it may be claimed that the actual experience of the Germans at the siege of Paris, where they used Krupp breech-loaders of a large calibre, attaining a range of eight thousand metres, has established the fact that a breech-loading gun of heavy calibre is formidable and effective; while the Italian experiments with the 100-ton breech-loading Armstrong gun are conclusive of the question.[1]

[1] The 110-ton guns for the English barbette ship Benbow are to be breech-loaders.

It will then be apparent that it is practicable to use, within the confined space of a railway wagon, any gun the dimension of which, from its trunnions back to its cascabel, does not exceed five feet; and this dimension allows the use of guns of a very large calibre. The muzzle of the guns, of course, would extend beyond the side of the carriage, but when in movement the guns could be traversed parallel with the rails.

It seems that it might be most convenient to mount these guns in pairs, as in the turreted ironclads, when not of the heaviest weight.

The carriage of the guns would necessarily turn on a pintle; and the carriage best suited, whether an ordinary barbette carriage or one on the Moncrief principle or any other, is a matter of detail to be developed by study and experience.

SECT. 49. It being shown that the gauge of railways offers no impediment to the use of guns of large calibre, the question of the practicability of firing must be considered.

It may be said that the recoil of heavy guns would be too great, and would crush down the rails and could not be controlled within the given limits. Several years ago, when this subject was first considered, long studies were entered into to furnish an answer to the above objections; but they have been conclusively settled by the experience of the Italian and Eng-

lish authorities, who now use a small railway to fire from when testing their heavy guns, as was the case when the 80-ton and 100-ton guns were tested.

The pressure of the recoil can be distributed on six or eight pairs of wheels, and the pressure on the rails can scarcely exceed that exercised by the adhesion of the driving wheels of a locomotive weighing sixty-five or seventy tons, and moving trains weighing over three hundred tons at thirty miles an hour or more, as is frequently done.

If, however, the practicability of using railway batteries should not be conceded after the foregoing statement, a further illustration may be found in the following incident.

SECT. 50. No pretense is made by me to be an original discoverer in putting forth the idea of the use of railway batteries.

This idea is an old one, and plans and projects in relation to the construction and the use of these batteries doubtless abound in the archives of the War Departments of most countries. Whatever of originality that exists in my ideas is to be found in the endeavor to frame a complete system based on the use of these batteries in great numbers as mobilizable fortifications upon railway lines, whereby they would become strategic lines, the holding of which would decide the issue of the campaign; and to demonstrate that the objections that

have heretofore caused the rejection of all proposals to construct railway batteries cannot stand the test of analysis and study.

Sect. 51. However, it was my fortune to witness perhaps the first fire that was ever delivered in actual combat from an armored railway wagon.

During the American Civil War, in 1862, the Confederate authorities prepared in Richmond a railway battery armored with railroad iron and carrying a 32-pound gun in front of the engine. The iron shield only covered the front of the battery, and was pierced by an embrasure, but the sides and rear were unprotected.

When, in June, 1863, Lee made his flank movement against McClellan, one of the Seven Days' battles was delivered on the line of the Richmond & Yorktown Railway at a point called Savage Station.

The iron railway battery was sent out on this road from Richmond, and Major-General Magruder, commanding the Confederates at Savage Station, ordered this battery to advance and fire on the enemy.

It moved, propelled by steam, down the track and passed into a deep cut, which protected it, and from this cut opened with its 32-pound gun, and burst its shell beyond the first line of the Federals and over the heads of their reserves, forcing them to shift position.

About the same time, the skirmishers of the

opposing forces became engaged and the lines of battle were deployed, resting on the right side of the railway.

The Union line was a little beyond the cut from which the railway battery fired, and at right angles to it. If the battery had advanced, it would have completely enfiladed the Union line at short range, and must have broken it; but, owing to the fact that the sides and rear of the battery were open and exposed to the fire of the skirmishers, and to the further fact that the field of fire of the gun was limited by its embrasure, the battery could not advance; and as the skirmish fire approached it withdrew. If guns had been mounted *en barbette* and the gunners and machinery protected by only bullet-proof armor, and if there had been half a dozen such batteries, they could have easily broken the Federal line of battle, and have cut off their reserves, large numbers of which were stationed on the left of the track.

This is beyond challenge a demonstration that there is no practical difficulty in using armored batteries and heavy guns on rails; and the failure to obtain decisive results is explained by the unskillful elaboration of details. Recent experience in Egypt confirms the feasibility of using artillery mounted on railways.

It is said that during the siege of Paris the French constructed armored railway batteries; but I have been unable to obtain any data in relation to them, if the statement be true.

Reason and experience alike prove that there is no obstacle in adapting railways to the use of armored and unarmored batteries carrying heavy guns and endowed with the greatest mobility.

CAN ARTILLERY ON RAILWAYS COMMAND THE ADJACENT BELTS OF LAND?

SECT. 52. II. The practicability of moving and firing artillery on railways being established, it will be contended that no advantage of importance can be realized from this fact; that the nature of railways, their levels, the adjacent hills, and the deep cuts, all combine to make a railroad incapable of defense, even if protected by iron-clad batteries.

It will be said that railways are approachable under cover of hills and elevated plateaux; that the range of guns on rails would be limited or masked by hills, ravines, and deep cuts, which would constitute so many covered ways for an enemy, behind which he could accumulate his forces, and thence in perfect security destroy by sharpshooters the artillerymen of the batteries; or open heavy artillery and destroy the batteries, or by rush carry them; or gain the rails and tear them up, or pass and cross the road at pleasure.

It may be said that a common highway is more easily held than a railway; that one goes

over the surface of the ground and mounts elevations and hills, and hence guns placed on it would have a wide command; while a railway sinks through cuts and pierces hills, whereby guns on it are completely masked, except at points which would be avoided by an enemy, who could approach on the higher grounds, within pistol range of the batteries, and yet be under cover.

These are some of the objections that may be urged against arming the railways. They are formidable, and if any one of them be true it will necessarily be fatal to the theory which I hold; and they are so apparently well founded that they have heretofore doubtlessly been deemed sufficient to prevent the extensive construction of railway batteries.

SECT. 53. *Lines of railways are located by engineers on a profile, as near to the general level of the country as possible; and generally climb or descend small gradients.*

SECT. 54. It follows absolutely from this simple principle that generally three fourths of a railway line is on or above the general level of the country it passes through, and that guns elevated from three to six feet above the rails must have command over extensive districts. Half of the profile will strike the general level of the country; and one quarter, passing over meadows, valleys, and bottoms, must be elevated on embankments above the adjacent ground.

It is useless to say that there are roads where this principle does not govern. Exceptions abound everywhere, and are to be treated by exceptional methods; but the general law of the profile of railways is fixed and unalterable, and its truth will demonstrate itself to any one who will simply ask himself, What would be thought of an engineer who would locate more than half of the line of his road below the general level of the country he passes through?

Railway cuttings are made in obedience to the law that the profile must follow the general level of the country; and, when an elevated plateau or range of hills is reached, the cutting is made from the general level of the surface on one side through the elevated plateau, until it encounters the same general level on the other side.

There are then, necessarily, most generally three fourths of a railway line where batteries on its rails would have command of the adjacent country; but it will be said that this command will be very limited, because neighboring hills and undulations afford cover behind which an enemy could operate effectively against the batteries.

SECT. 55. In addition it may be claimed that, even conceding the command of guns along three fourths of a line of railway, yet the cuttings through the elevated plateaux and hills allow an enemy to approach so near that he can

easily cross to the opposite side and then find the same cover, whence he can destroy the batteries or the track; and that a line which can be broken at fixed points for one fourth of its extent is an untenable line.

The hills that rise above the general level of the earth either are isolated and detached, or are connected together and thus form a continuous range.

When the hills near the railway are detached and isolated, or are separated one from another by ravines or little valleys, it follows, if the whole line of road be armed with batteries extending far to the right and left of any isolated hills which may be sufficiently near to the track to afford a dangerous cover in an attack on it, that the slopes and approaches to such cover will be commanded by one or more batteries on the road to the right or left.

If we assume that the batteries mount guns of an effective range of four miles, then these slopes and approaches will be exposed to fire from batteries at any favorable point in a line eight miles long. No efficient concentration of force could take place, and no efficient advance could be made, when a flank and front fire of continuous batteries extending for eight miles could be brought to bear on the enemy. Even if an enemy could gain the cover, how could he leave it or advance in face of such an exposure? He might possibly gain the cover of

isolated or detached hills distant two or three miles from the track, but it would be impracticable to do so if the hill were within a less distance.

It is not possible for any range of hills to cross a line of railway without exposing its slopes, crests and approaches, to overwhelming fire.

When a range of hills approaches a railway and then bends back, its rear, slopes and side near the angle of the bend, but not elsewhere, are protected and form cover, except from vertical firing.

It is like a salient projected into an enemy's line. Sometimes a range of hills will run parallel to a railway for some distance and then bend back.

These formations are exceptional; and when they or other exceptional conformations of contour are found along a line of road intended to be fortified as a military line, special arrangements must be made to overcome the difficulties they present. They may be said to resemble a mountain impassable except at one or two points, or a river having two fords. The skill of the engineer must be called on to furnish supplementary and auxiliary means to protect the fortified line.

In the case of the above described conformation of ground, it will not be difficult to establish on the crest of the hills positions

which will command the covered slope and approaches, and these positions will be protected by the batteries on the railway from attack from any quarter except from the front, while the communications of the position will remain open.

SECT. 56. Let us suppose that there be a cover for the enemy, who may gather under it, near to the batteries; but if it be cover for the enemy it is also cover for the batteries. If the enemy be safe as long as he remains under cover, so are the batteries; but whenever the enemy attempts to come out of his cover to attack, or whenever he even fires, he exposes himself to the front and flank fire of the batteries, the intensity of whose fire grows greater the nearer the cover may be to the fortified line. Even if the cover protect the enemy from the front, flank, and vertical fire of the batteries, posted at any point within eight or ten miles, yet inevitably the covered position must have an exposed flank or rear; and the railroad lines will not have been prepared properly if means have not been studied out in times of peace, showing how the cover may be swept by fire in front, flank, or reverse, either by guns on the fortified line or in salient or flank positions.

An exceptional conformation is also sometimes found when a succession of isolated hills dot the country, just as if rolling waves of earth

had become suddenly solidified; and, if this conformation form advantageous cover for an enemy, advanced and auxiliary positions must be prepared.

SECT. 57. An exceptional contour of land adjacent to railways is found in the hills and heights that overlook river valleys, under the fringe of which roads are built.

Examples of these riparian roads are numerous. Of this kind are the railways near Paris, from Suresnes to Versailles, and from Meudon to Versailles, where the roadway skirts the highlands as they fall into the valley of the Seine. Of the same class are the railway along the Marne, and that from Amiens to Abbeville skirting the valley of the Somme; and many others, like those at intervals along the Rhine from Cologne to Heidelberg, or that across the Brenner Pass of the Tyrolean Alps skirting the banks of the Adige.

These riparian roads are exceptional, and form but an inconsiderable fraction of the railway system of a country; and, while they, as well as excessively hilly countries, offer difficulties in the way of defending railways, nothing is presented that cannot be readily dealt with by adapting additional means easily within the resources of intelligent military science.

SECT. 58. Many other exceptional and difficult features abound. The country around Paris is very hilly and broken. Independent

of the hills along the valley of the Seine, the country along the Marne and its confluents and to its north is full of hills, piled over the plain irregularly and separately.

It is difficult to imagine a more difficult country, yet it is pierced by railways leading to Strasbourg, Mulhouse, La Varenne, Troyes, and Lyons.

As difficult as are these and other sections around Paris, yet the Germans in the war of 1870 established and held fortified lines through them, crossing these railways.

If these lines could be fortified and held — notwithstanding the nature of the hills and the cover they gave to attack — without the aid of batteries on railroads, how much more effective could their defense have been if fortified along the line of railways, fitted with mobile batteries and strengthened by segmental and salient roads and by entrenched positions, under cover of the artillery on the road!

It is not proposed that batteries should be merely mounted on railways, and then, without further preparation, launched out to repel an enemy; but it is proposed that the land adjacent to the railway should be studied in time of peace, and auxiliary protection be prepared to supplement weakness and to render the line inexpugnable.

Assuredly, if the German soldiers could successfully hold their line over this hilly country

against the courage and the desperation of the French, who in superior numbers, under the brave General Ducrot, in November and December, made vigorous and formidable sallies, resolutely seeking to break through the German lines, it cannot be denied that a skillfully and carefully fortified railroad line passing through the same hills could have been made even stronger.

It is well known that the Germans, while investing Paris, protected many of their batteries by armor formed of iron rails or other material. At Chatillon over fifty metres of armored protection were erected. If in active campaign the Germans could so protect and fortify their encircling line of investment, what could not France have done in preparing and defending a system of fortified railway lines, if the enterprise had been seriously and intelligently undertaken in time of peace! One single fortified line of railway would have prevented the investment of Paris by the Germans.

The northeastern frontier of France is a hilly and difficult country, and so is the Belgian eastern frontier, but these difficulties can be overcome by skill and timely preparation.

SECT. 59. But of all countries where railway defense can be made most formidable for least outlay, England is the best.

It is so subdivided by railways that no army of fifty thousand men could operate without

crossing many iron tracks. The number of roads already constructed would afford a facility for opposing columns of railway batteries against an enemy, if he should ever succeed in effecting a landing.

The actual railway mileage of Wales and of southern and central England is so extensive that every acre of their entire area, on an average, would be swept by guns having a four-mile range, mounted on the existing commercial roads; and while this may not be true as to special localities or even small districts, yet as a general average it is true; and the exceptional localities would be only islets, capable of being enveloped by a surrounding sea of artillery fire, and of no practical utility to an invader.

The whole railway mileage can be converted into fortified lines by the preparation of railway batteries in sufficient numbers, having reference to their mobility.

I have several times given a cursory examination to the country along the North Downs, in Kent and Sussex, and the sea-coast; and the country is well adapted for the arming and defense of railway lines. For a cost not exceeding that of the ironclads Devastation, Inflexible, and Benbow, the whole of England can be made, with the aid of a handful of troops, absolutely impregnable.

If the railroad lines be armed and properly

prepared, if auxiliary railways and positions be designed and constructed, no battle would ever be fought at Dorking; nor would the best position to cover London be found extending from Guilford through Dorking and Red Hill to Tunbridge, as Captain Barrington assumes in his interesting work of "England on the Defensive."

In elaborating my theory it has been pleasant to hope that something may be suggested to make the future of Great Britain more secure, so that the eye and hand of Christian and free civilization may find resources to resist the emergencies of invasion.

SECT. 60. I have critically examined the environs of London, and have considered the important question as to the best method of fortifying this great heart and seat of empire of the Anglo-Saxon race in case, by some disaster, the command of the English Channel should pass to a hostile power who would press the siege in overwhelming force by land and water.

This same question has occupied the study and labor of some of the brightest English minds; and a whole library of literature is at the service of any one who feels interested in the subject.

The studies of Colonel Shafto Adair, made over twenty years ago, based upon actual surveys and measurements, and illustrated by a carefully prepared model, are of profound interest; while the works of Palliser, Frazer, Bar-

rington, and others, have exhausted the various theories of defense adapted to the actual system of war. But when I witnessed the enormous extent of London, surrounded by populous suburbs and districts, I was much impressed with the limited area proposed to be held and the enormous aggregation of buildings left to be thrown out or destroyed in order to give a proper field of fire to the defending guns; and when the great range of the Krupp and Creuzot guns was considered I felt appalled at the havoc and destruction that would fall upon the devoted city.

Even the very extended contour of fortification proposed by Captain Barrington, and requiring the investing lines of the enemy to be seventy-five miles in extent, would bring large and populous areas under range of fire, especially in the salient projected on the eastern side, and intended to cover Woolwich. Looking upon these various plans, regarding the ground itself, and considering the sequence of events that must transpire before London could be invested, my mind could reach no other conclusion than that the best system suggested, while intensifying the sufferings and losses, might delay but could not prevent the inevitable surrender.

But how different would be the result if hundreds of batteries, mounted on railroad wagons and propelled by steam, electricity, or other

motors, were to occupy the various prepared and fortified lines of railway starting out from London, as their hub, like spokes of a colossal wheel. Then the lines of defense would be the sea-coast; and, as the enemy sought to advance into the interior he would literally impale himself on successive lines of fortifications, which would grow stronger as he advanced. Thus would be solved the problem of the defense of London, which would never even hear a gun fired against its outward walls.

The iron-clad island with a thousand iron lines of fortifications, only to be doubtfully attacked by regular parallel and sap carried on with great and imminent hazard of mishap over every acre of advance from seaboard to the interior, would be safer than when the "silver streak" separating her from the mainland was ploughed only by sailing ships, and was subject to her undisputed control.

SECT. 61. The same results can be achieved in France if, instead of expending her resources in enlarging the fortified belt of Paris, in protecting the intrenched camp at Langres, and in building fixed and detached fortifications on her first line, she would adopt a system that can substitute, for immovable works and guns, mobilizable batteries; and, for lines that can be flanked, fortified lines, without flanks or rear, along her thirty-two thousand kilometres of railways, and covering by a hundred intrenched positions every avenue of invasion.

SECT. 62. In the United States of America, there is felt but little apprehension of the ability of an enemy to invade its interior; but we have the most exposed and tempting seaboard in the world, dotted with rich cities and towns, offering great prizes to ships-of-war that might compel surrender or ransom. In addition, small bodies of marines and troops could be landed, under the protection of the guns of an enemy's fleet or by surprise, and cause enormous damage. We have neither guns nor a fleet to protect us; and even torpedoes cannot be relied on, as the naval powers of the world have learned methods of robbing torpedo defense of most of its supposed strength.

Any system of defense for our seaboard that we may adopt will demand the building of heavy guns and strong fortifications.

The European engineers have built many iron-clad batteries, at enormous expense, but the influence of these is restricted to the field of fire of heavy and immovable guns confined to a fixed and limited locality.

It is to be hoped that our military authorities will not fall into the same errors, but will seek to avail themselves of all the appliances which inventive science has placed at their disposal.

For example, the port of New York can be better and more effectively, and at one quarter of proposed cost, defended by railway batteries

armed with mobile guns, whose influence and fire would not be localized, but could be concentrated upon any point where their presence might be needed.

Lines of railroads could be built along all the threatened points of approach, and at intervals positions for guns could be selected, behind cuts or prepared positions, affording shelter to the gun-carriage and car upon which the gun may be mounted.

These guns *en barbette* would command a full field of fire, while carriage and men can be as well protected as in casemates; and the facility of instant concentration at any threatened point, and the ability to shift position and follow any ship passing by them, would give them irresistible energy in defense.

When the hills, as on Staten Island, approach near the water-lines, special strength could be developed by sinking the railroad into cuts, thus forming unrivaled cover; and this same system could be adopted even on level lands.

Then, instead of placing on Long Island and Staten Island, and the other points selected for defense, large numbers of guns, amounting to hundreds, which would be fixed and immovable and would only be employed in limited fields of fire, the system I recommend would dispense with at least one half of the guns and would enable a far greater number to be used at the points of combat, and if guns be able to

destroy iron-clad ships would certainly accomplish their destruction.[1]

The whole New England coast, with its rich villages and factories, is exposed to be ravaged by any power having the command of the ocean or able to send swift cruisers to surprise and destroy it. But along this coast run parallel lines of railway that could be cheaply prepared for defense. Groups of heavy artillery could be held at points twenty-five miles apart, and when required immediate concentration could be made at the threatened locality.

The Atlantic and Gulf coasts offer equal facilities for defense, while the level banks of the Mississippi are most favorable for the employment of this system.

Having endeavored to show that it is practicable to mount heavy guns on railroad batteries; that when so mounted they will command, with limited exceptions, the adjacent belts of land within the range of their fire, I shall endeavor now to consider the capabilities of the system of railway defense by means of batteries mounted and movable on the rails of the railway.

[1] See Appendix.

CHAPTER VI.

THE SYSTEM OF FORTIFYING AND DEFENDING RAILWAY LINES.

SECT. 63. The capabilities of a system rest in the power of its agencies and the opportunity for their employment.

The defense of a railway implies the construction of the best and most effective appliances for its protection. These are to be found in mobilizable fortifications capable of concentration with their heavy guns ready for service at threatened points, instead of fixed and permanent works and guns.

SECT. 64. Let us take a section of a railway one hundred miles long, and illustrate the theory in relation to its defense.

It is not intended that only a few batteries be placed on this section; there must be enough to hold it against attack at any point. Railroad batteries ought to embrace many classes, some armored, some unarmored, some mounting heavy and others lighter guns.

The first object sought should be to keep the guns and masses of the enemy as far distant

from the railway as possible. For this purpose guns far heavier than any that could be brought against them should be used. At the siege of Paris the Prussians used the Krupp long cannon of twenty-four. This gun weighs twenty-five hundred kilogrammes, and shoots a shell of over twenty-seven kilos to a distance of eight thousand paces, as was shown by the Battery le Bourget No. 21 throwing shells into La Villette.

Therefore, the heavy guns of a railway battery should have a range largely in excess of this, as an invading army could bring a siege train containing guns having a range of three miles. There being no difficulty on a railway in transporting and firing guns having a range of six miles, a failure to do so would lose one advantage of the system.

The vast aggregation of men and material required to constitute an army offers a mark easily attained at six miles by heavy guns, bursting shell, or case shot, of a power to sweep a fifty-acre field; and a line of ten or twelve such guns, at proper intervals, would render the movement of a large force impracticable in the belt of land subject to their fire.

There is no reason why these guns should be armored, as they are not intended to be fought at short range like guns of less power; but it would be well to provide an iron shield to protect the men from infantry fire.

If all the guns of railway batteries were to be fought *en barbette* from unprotected wagons, they would only be subject to the same exposure that the field-guns now incur in battle, as they are mostly fought without any protection whatever. In fact, the railway unarmored batteries have over ordinary field-batteries the enormous advantage of a mobility that allows them to seek cover behind railway cuttings or hills when the fire grows too hot, and, for this purpose or even to advance, to move when under fire.

SECT. 65. As the theory requires that the railway line should be so overwhelmingly armed with artillery that the enemy would be disabled from bringing any of his artillery, drawn by horses, sufficiently near to the railway to disable its batteries, it may be doubted whether any armor would be required upon properly prepared lines except sufficient light shields above and below the guns to protect the gunners from infantry fire; and in this view all the railway guns could be mounted *en barbette.* Assuredly a more thorough and complete protection could be given by the use of a certain proportion of armored batteries. But the wagons mounting the light and machine guns should have shields or bulwarks around, and perhaps over, in such a manner as to resist escalade and to secure the gunners from infantry fire, even at pistol range.

The guns of longest range which may be designated as railway artillery of the first class, may be grouped in two-gun or four-gun batteries and scattered at intervals along the line. Where a railway approaches within ten or twelve miles of another road, then these first-class guns would dominate an extent of territory ten or twelve miles wide between the two roads and five or six miles on either side, or a twenty or twenty-four mile belt in all, within which it would be impossible for a large army, with its trains and long columns, to march, except under the condition of receiving a consuming fire to which no reply could be given.

SECT. 66. The effect of artillery is geometrically increased in proportion to size and range. Thus, the energy of the 68-pounder gun at a 1,000-yards range is 452 foot-tons; of a 25-ton gun at the same range is 5,165 foot-tons; of the 80-ton Woolwich gun is 25,000 foot-tons; and for the 60-ton Krupp breech-loader an excess of energy over 25,000 foot-tons is claimed.

It results that a 25-ton gun is equal in energy to eleven 68-pounders, and an 80-ton gun to fifty-five 68-pounders; and a 4-gun battery composed of 25-ton guns would equal in energy forty-four 68-pounder guns. Whatever may be said, no one can deny that military operations on a large scale would become impracticable under an exposure to the fire of guns of a less

weight than 25 tons. While in the absence of experience it is not undertaken to say what is the gun best adapted to railway service, yet it is claimed that it is easy to transport and fire from guns as formidable as 25-ton guns in case it should be deemed desirable.

To obtain the full advantages of the system of railway defense, guns of very long range should doubtless be used. The accepted idea of naval warfare is to augment the size and diminish the number of guns.

SECT. 67. Before 1859 the most approved naval ship carried 120 guns; now, in the English Navy, the Devastation, of 9,188 tons, carries 4 guns; the Inflexible, of 11,165 tons, 4 guns; the Hotspur, of 4,010 tons, 3 guns; and the Glatton, of 4,840 tons, only 2 guns!

If the best naval skill in the world has judged that the perfect ideal of marine war is to build a ship or floating citadel like the Inflexible, which devotes 2,791 tons of ship's displacement and £125,000 of expense to each heavy gun, it certainly is worthy of the gravest consideration whether military science may not find important advantages in the same direction by the augmentation of size and capacity of guns, and by the adoption of a system which can endow powerful guns with a mobility greater than at sea, at a cost of equipment comparatively insignificant.

English science is not solitary in these con-

clusions, for all the great Continental powers have built ironclads, at enormous cost, which often devote two thousand tons to the carriage of a single gun; and Italy has even surpassed England in the weight of her heaviest marine guns, though the English have now designed some of one hundred and ten tons.

When it is considered that in naval warfare a ship has most generally only other ships as targets to fire at, and that the hazard of making a misshot from its huge guns, fired on a rolling sea and therefore with unsteady aim, is very great, — the soldier should be encouraged in the expectation of producing great results when the huge gun to be used by him is fired from a steady platform at an object as large as the moving columns of an army, the distance of which is well known, and when every fragment of its bursting shell or case-shot will assert its destructive influence.

Sect. 68. It may be objected that guns as large as those spoken of cannot be fired from rails without crushing them down, as they would mostly be fired at an angle with the rails, and not parallel with them, as when fired at the English practice and experimental butts.

This may or may not be true, as we have no experience of angle-firing; but a system of adjustable props or columns to rest on the earth and take off some of the power of recoil may be readily used if the ten, twelve, or sixteen wheels

supporting the battery on the rails should not prove sufficiently numerous to distribute the pressure to such an extent as to enable the rails to bear the lateral wrench and strain of recoil produced by angle-firing.

The use of heavy long-range guns within the confined gauge of ordinary railways has never been tested except for firing parallel with the rails, and the ability to mount these guns and to fire at different angles to the rails is yet to be practically demonstrated.

It is possible that it may be desirable to use heavier guns than the limited dimensions of the railway wagons will permit, but the size and range of guns to be used must be decided by practical tests, which may or may not show that the estimates of capability have been excessive.

SECT. 69. But if for any cause it should be ascertained that heavy and long-range guns of the desired dimensions cannot be practically fought within the narrow limits of a railway wagon, this will only add small additional burdens to the work of defending the railways.

It is beyond doubt that guns largely in excess of calibre and range of any capable of being used as field-artillery can be used and fought from railway wagons, and this will give the fortified railway line a decisive advantage over any field-artillery of the enemy; but it may be said that heavier guns than the railway can use may be brought by land in a siege train.

While this is seriously doubted, yet in the absence of experience it may call for the suggestion of a method to meet the supposed difficulty.

The capacity to transport over railways even 100-ton guns has been demonstrated and is unquestioned, and therefore the heaviest guns demanded for the exigencies of railway defense can be mobilized and carried over the rails; and, if it be impossible to fight them from the railway wagons, revolving platforms can be prepared for these guns off the main track, and the gun and its carriage switched on to them and the guns fired from these revolving platforms. The recoil would then be received exactly as at the Italian and English trial butts, when this gigantic class of artillery was tested by frequent firing in a line parallel with the rails.

Some time has been devoted to the consideration of the questions in relation to artillery of the heaviest calibre, because, if the advisability of using it and the capacity of railways to permit its use be established, it follows that lighter artillery can be used to any extent desirable.

It would seem that, after a sufficient number of heavy guns are provided, they should be interspersed among batteries mounting lighter guns.

SECT. 70. As it has been advocated that a first belt of land should be commanded by guns

of the first class, possessing possibly a six-mile range, it is now proposed that a second belt should be effectively commanded by guns of the second class, having a four-mile range, and a third belt by guns of the third class, having a range of two miles, and decidedly superior to ordinary field-artillery.

The object to be held in view, if an enemy should pass through the first and second belts of land, is that when he enters on the third and approaches the railway a mass of fire should be developed sufficient, under ordinary conditions, to destroy him; but if he pass through it and reach the railway he should then encounter the resistance of men garrisoning the batteries, protected from his fire, and using machine and volcanic guns behind a fortification which should be literally invulnerable to his attack.

SECT. 71. It is to be remembered that railways armed as above indicated *form lines that have no flanks or rear;* and that, always overlapping the line of attack, the railway batteries turn and enfilade the attacking flanks and possess the ability to move under fire and to bring, with unequaled celerity, fresh support in men and guns to those points of the line where the attack grows strongest.

SECT. 72. While the correct and perfect type and armament of armored batteries must be ascertained by experience, yet it is evidently

within the capacity of railways to easily transport a battery armored with four and one half inches of iron, which is the thickness of armor of the British ironclads Warrior, Black Prince, Achilles, etc.

The *cuirasse* of the armored battery, in case it be used, should taper from the rail upwards, in order to keep the centre of gravity low and to afford better protection to the wheels.

It has been calculated that a battery eight feet by thirteen and six feet high, with an armor four and one half inches thick at bottom and four inches at top, would offer ample room to mount two pairs of moderate-sized guns, or four guns in all, each weighing twenty-five hundred pounds, with their carriages and ammunition, and four machine guns; and that the whole battery thus equipped would weigh a little over fifty tons, of which the iron armor would weigh about two thirds of the whole.

Now, if this armored battery be sustained by ten wheels, each wheel would support five tons and each axle ten; and if this pressure, in addition to that of recoil, be too great it can be reduced by increasing the wheels to fourteen, or seven pair; and even then each wheel could be twenty-four inches high.

This calculation has not been stated as exhibiting the best type of an armored battery, or as indicating the idea that an armor as thick as four and one half inches would be required;

but it was made for the purpose of establishing clearly the capabilities of the system contended for. At the time of making the calculation I devised the whole details of the construction of the battery, with suitable arrangements for firing and protection.

It was proposed that above the armor there should be a flat inclined bullet-proof roof, projecting a little over the sides, and resting on adjustable braces or supports, so as to leave an open space between the armor and the roof, which open space was to be protected from rifle fire by movable shields. The roof protected not only from the vertical and plunging fire of sharpshooters, but from rain, and is capable of being more or less elevated, and constitutes an absolute defense against escalade, or *coup-de-main ;* while half-a-dozen men, in perfect security in the battery, could work the machine guns, throw hand-grenades, and use repeating rifles against an exposed enemy, who could not even get into the battery if left unsupported by artillery.

The plan and details were worked out in order to give assurance, based on calculation and practical specifications, that the capacity of these railway batteries within the ordinary railroad gauge had been properly estimated.

The true type and plan for such batteries will only be discovered by those practical experiments which a government alone can make.

SECT. 73. It is proposed that the various classes of artillery should be intermingled in reasonable proportions, and in such numbers as to bring every acre of land along the railway under consuming and unendurable fire. Batteries stationed half a mile apart would bring every point of the road under the fire of guns only four hundred and forty yards distant; at which distance machine guns, worked by two or three men, would deliver every minute the fire of a battalion front; and as these batteries are to be endowed with mobility there is a capacity to close the intervals until a solid wall of destructive fire arrests the attack. It is not intended that these batteries should be left without support and a skirmish line; but the method of attack and resistance will be considered further on.

SECT. 74. To develop the full capacity of this system, the railway batteries must be endowed with mobility. If each individual battery had an independent ability to move itself, its capability would be enormously enhanced, as it could then move and shift positions in the crisis of attack.

This could be accomplished by steam or electric power, and but little fuel would be needed, as it would only be required while in actual combat. Mechanical contrivances, such as powerful cranks and the like, might be adopted; or horses or even men alone; finding

protection on one side of the battery or behind cuttings, embankments, and hills, might be utilized.

Platforms for the use of Nordenfeldt, Gatling, revolver, or Maxim guns should be provided, and these platforms should be so arranged that they could be lifted up by suitable mechanical contrivances say fifteen or twenty feet above the rails. These volcanic and machine guns could be fired by men protected by bullet-proof walls around the platforms, whenever infantry came within range; and, as there would be a facility for elevating and depressing these platforms, the elevation could be deferred until an opportunity offered for the use of the guns upon them.

The advantage of endowing the railway batteries with independent mobility is so great that every effort should be made to secure that result, and electricity possibly seems the best agency for this purpose. If this subtle agency could be used it would offer, in addition to motive power, facility for handling guns and ammunition, elevating and depressing machine guns, and lookout stations. It would not be difficult even for men or horses to move the unarmored batteries, or those armored, only against infantry fire, in default of other power.

But the application of electricity as a railway motive power has come into use in Berlin and other localities. The Daft system, as tested

in America, transmits a low power along the rails, so that a man can touch them with impunity, and the dynamo receives power directly from the rails themselves. Storage batteries might be used for many purposes.

There seems no reason to doubt that science can readily provide means to endow the batteries on the railway with mobility, in a cheap, convenient, and useful manner.

Armored locomotives built low might be interspersed on the railway between the batteries in convenient numbers, or placed upon a separate track and thus be enabled to move the batteries for concentration on menaced points, or for any other object.

When there is a double or triple track road, one track might be surrendered to the batteries, and the other could be utilized for the transport of men and material and for the use of armored locomotives.

Doubtless, on lines carefully prepared, it would be found convenient to provide sidings for the batteries into which they could be switched by the use of permanent or temporary switches carried by each battery itself; thus leaving the tracks open to such movements as might be required.

Along the unoccupied tracks, bodies of troops in railway wagons protected by bullet-proof ramparts could be moved to and fro, as the exigencies of the situation might demand.

SECT. 75. Necessarily, an exact study of the lines of railway which each country may propose to arm would be made. This would enable all the points where an enemy under cover may approach the lines to be carefully noted, and positions to be indicated or prepared, commanding these points.

At suitable intervals, determined by the nature of the ground, preparation ought to be made to construct salient and segmental roads, that is to say, roads forming the segments of an irregular circle springing from and at times returning to the main road, at such distances as the nature of the ground may indicate, in order to insure full command of positions in front. Segmental and salient roads can be temporarily laid with great rapidity, and will permit batteries to advance out on them for the purpose of encountering any attack, or driving back skirmishers, or destroying artillery moved by horses.

In examining for these salient roads, the engineers will be governed by the locality, and will extend the roads to such points and distances as will give great command of fire and enable the enemy to be held at arm's length from the railway and the batteries.

No reasonable objections as to the cost or difficulty of laying salient tracks can be alleged, as the rails would only be sufficiently heavy to permit the passage of the batteries at a slow

rate of speed, and would be attached to stringers or cross-ties in such a manner as to be placed on the ground and used without the necessity of making a substantial road-bed, such as railways require to endure the shocks of heavy trains moving at the rate of forty miles an hour.

The positions could be selected and the material prepared, and then stored away for future use.

SECT. 76. Portable tram-roads have entered into extensive and varied use, and are rapidly laid or shifted. The sugar planters of Louisiana and elsewhere are using these iron tram-roads extensively. The weight of the rails is from ten to fifteen pounds per yard, and the rails are held together by iron or steel cross-ties, and the sections of rails are easily connected by various devices.

Over six tons, exclusive of the weight of cars, can be transported on the trams by a single horse.

These trams are laid and shifted many times each day, and I have seen four men lay and shift five or six times a day a single line of one thousand feet, so that in a day they shifted and made over a mile of road, beside transporting on foot the rails three hundred feet.

The rails are laid upon the surface of the ground without preparation, unless some unusual difficulty is encountered. It seems per-

fectly feasible to prepare rails weighing not much over twenty pounds to the yard, to connect them by corrugated steel or iron ties into fifteen or twenty feet sections, and to lay them, when needed, with the greatest rapidity as salient, segmental, or junction roads. In laying these teams, the wagons transporting the rails advance upon the tracks as soon as laid, and hence the work progresses rapidly.

There is a system of switches used in the portable trams made by Fowler & Co., of England, which allow cars to pass off the main line without interrupting the travel; and these switches are placed upon, and removed from, the main track, without any detention whatever.

There is no reason why these tram-rails could not be laid at the rate of ten miles an hour, and of sufficient strength to allow the passage of wagons weighing twenty tons or more, capable of transporting, at low speed, guns and ammunition.

By applying this system of switches, batteries could be switched off and on the main track for all the purposes of the campaign.

Thus the main line might be left clear of batteries for the movement of troops and armored locomotives until the approach of the enemy, or even until actual combat. The batteries carrying the heaviest guns might be switched off the main track and fired from sidings in selected

and favorable positions, thus allowing the lighter batteries and machine guns to move rapidly up and down the main track.

Just preceding combat, or even during its progress, these portable trams could be laid on selected lines and batteries advanced over them in the very crisis of battle. It is difficult to indicate all the possibilities arising from resources like these. Lines of trams could be built across or in rear of an army. A sudden and concentrated attack upon the communications of an invading army could be aided by parties laying, upon ground carefully studied, successive lines of temporary railways, upon which heavy and light bullet-proof batteries could be advanced, to completely sever or to isolate the forces of the enemy. This facility of attack would make it perilous for an enemy to disregard a fortified line of railway and march past it.

SECT. 77. The possibility of using these agencies being once established, it follows that the whole system of war and the organization of armies must be modified.

It is necessary always to bear in mind that peace permits each foot of land adjacent to the railway to be studied and prepared for defense, and that the railways and their adjacent belts of lands are in the quiet and peaceful possession of the defenders before the enemy appears.

The art of building and managing railways

would become a branch of military study, and every device that ingenuity might invent or frame would be adopted for the convenient movement of the batteries, so that one might pass another, or leave one track and gain another, or traverse the segmental and salient lines.

In preparing railway lines for defense, it would be necessary to provide sufficient rails to make the defense effective. Whatever the engineer judges necessary must be provided, and if more tracks be needed he will so report.

What I conceive to be the most effective and perfect form of defense consists in having two or more parallel fortified lines of railway, so that when the enemy attacks one line he will encounter the fire of two lines, and if he should succeed in making a lodgment on one line the fire of the other would arrest him. These double lines may be built as parallel roads, several miles apart, and may be connected by junction, salient, or segmental roads, springing out from the fortified lines at intervals not greater than eight miles apart; and this method seems to make an absolutely invulnerable line, as it is inconceivable how a successful attack could be made upon a fortified line, without flanks, protected by salients open to be occupied, and held by mobilizable fortifications that would exhaust and cripple any attack before it could approach the main defenses.

SECT. 78. It may be claimed that if you fortify and prepare a railway line, the enemy may disregard it, and passing it by proceed to ravage the unprotected country.

This might be attempted in a country having only railroads very distant from each other, but not otherwise.

If the invader be able to extend his march without touching a railroad, the conditions imposed by the proposed system have not been followed. It is a *sine qua non* that the enemy should be brought, if not across, at least so near a railroad that he cannot pass it without leaving his rear or flanks exposed to attack.

If the country be bare of railways, and if the government have not the means or prudence to provide against a condition like this, it would be vain to attempt to adopt this system of defense.

CANNOT THE ENEMY CAPTURE AND DESTROY THE RAILWAY AND ITS DEFENSE?

SECT. 79. III. It may be objected that if you arm and equip railways, the enemy, if in superior numbers, will gain the railway, tear up its track, capture the batteries, and cross and recross at pleasure.

Assume that one hundred miles of railway be prepared for defense. Topographical sur-

veys will indicate the strong and weak points and disclose the proper methods of defense.

Where the railway has easy command over a level country or over the slopes and approaches of hills in its vicinity, fewer fortifications or batteries will be required than at those points where the enemy may be able to find covered ways to come near to or to reach the railway itself.

No general rule can be laid down as to what may be the requirements of railway defense per mile, but the engineers must determine the necessities of these fortified railways according contour, like those of any other fortified line.

In favorable countries like Holland, Italy, and in certain parts of the south of France, the command of guns elevated six feet above the railways is complete and extensive.

In estimating for the number of mobile batteries capable of fortifying a line of railway a hundred miles long, neither too much nor too little reliance should be based on the fact that these batteries are able to be brought rapidly on threatened points, so that fortifications may be said to be improvised whenever needed.

This facility of concentration of fortifications and of men is enhanced by the fact that the fortified line will preserve instantaneous communication along each fraction composing it, by the use of electricity, telephones, signals, etc.; and the importance of this fact is evident

when it is considered that the enemy must disclose a serious intention to attack, by marching through successive belts of fire for a long time, before he is able to deliver it.

But too great reliance must not be based on the mobility of the fortifications, as it is essential that they should be capable of being extended so far as to make it impossible for the enemy to flank them; and if a hundred miles do not insure the essential conditions, the fortified line must be extended as far as needed.

The engineer will defend his lines with such number of mobile guns as a study may show to be necessary.

The fortified *enceinte* of Paris, about thirty miles in extent, was planned for 2,813 pieces of artillery and to be defended by 200,000 men, and its cost was about £5,600,000.

The German army in France at the end of the war had 1,674 pieces of field-artillery, fully equipped, independent of siege guns, which for the transport of themselves, ammunition, and supplies required not less than 25,000 animals.

It can scarcely be possible that the defense of a hundred-mile section of railway would require a thousand guns, exclusive of machine guns.

One thousand guns would, if equally distributed, be one for every one hundred and seventy-six yards, while every point in front of a gun would be covered by a flank fire extending to the right and left for many miles.

As guns would be grouped in batteries, the intervals between them would necessarily be greater than if they were scattered singly along the line; and the mobility of the guns and batteries would be such as to avoid the necessity of making each point of the fortified line as strong as if its defenses were fixed and immovable, as concentration could occur as the attack developed.

SECT. 80. The principle of fortifying a line of railway requires that a sufficient number of guns to defend it should be employed; and no fixed rule can be framed for all localities, as each has conditions peculiar to itself.

The number of men to make such a line effective cannot be arbitrarily fixed, but must consist of those required for the service of the guns and such supports as may be deemed necessary.

Mechanical appliances for loading the heavy guns can be easily adopted, while the use of breech-loaders enables the numbers of a gun detachment to be reduced. On an average, ten men per gun would be able to fight a thousand guns, and if this number be doubled for contingencies, then twenty thousand men would be sufficient to fight the guns of a line of railway one hundred miles long and fortified by movable batteries.

SECT. 81. A number of small gunboats for the use of the Chinese and the Japanese have

been built in England, and are described as the Alpha class, being a development of the Staunch class of the British Navy.

The Delta is a gunboat of the Alpha class, and carries a 12-inch, 38-ton Armstrong gun, firing a projectile of 800 pounds with charges of 130 pounds, and capable of penetrating over 19 inches of iron armor. In addition to this heavy gun, it carries two 12-pounder Armstrong and one Gatling gun. It is 115 feet long by 30 wide, and is driven by 270-horse-power engines. It is evident that the Delta is a formidable craft, and if it only had more speed, a half dozen around the Inflexible might cause her great discomfort.

The full complement for this gunboat consists of thirty men, so that the allowance of twenty men per gun, as proposed above, is a liberal allowance for artillerists. Nor is it necessary that artillerists of the railway batteries should be trained or veteran soldiers, though doubtless their *morale* would be better if they were. With improved range-finders, with accurate maps showing distances, and a few well-instructed officers, militia or volunteers after a few days' practice would prove very effective artillerists. This in itself is an enormous advantage, and renders the trained and disciplined soldiers of less importance.

SECT. 82. The hundred miles of railway, fortified by mobile batteries carrying a thousand pieces of artillery besides machine-guns and

20,000 men, and prepared for defence by the construction of salient and reëntering lines extending in segments of irregular circles beyond the front line, can be made still more formidable by the use of properly constructed wagons, covered with bullet-proof armor, and capable of moving by steam or other power on the ordinary surface of the ground, when favorable, or along prepared roads or tramways in front of the lines to be defended.

These bullet-proof wagons can be used as skirmishers for the defense of the fortified line against the skirmishers or infantry of an enemy who, unable to bring artillery with them, might swarm up to the railway under cover of hills or ravines. When necessary the wagons can find shelter between the salient lines and thereby intensify the fire which may protect the fortified line.

It may be stated generally that the number of supports may be reduced in proportion as the railway line has been carefully studied in time of peace, and prepared with armaments and auxiliary roads and works.

With a line properly equipped, it is difficult to understand conditions that would require over eight hundred men to a mile as supports for the artillery, or eighty thousand men to the one-hundred-mile section. The facility of moving men and throwing them on threatened points is so great that a reasonable reliance can be made upon it.

CHAPTER VII.

HOW CAN AN ENEMY ATTACK OR CARRY THE FORTIFIED RAILWAY LINE?

SECT. 83. It is to be borne in mind that before the enemy arrives, the railway is in full possession of its defenders, its batteries and supports in position, and the whole ground carefully studied and examined.

Unlike other fortified lines, that being necessarily limited in extent can be flanked, the enemy cannot turn the railway line, which extends over the whole country in which the advance is to be made.

The common taunt to the engineer—that he can fortify lines or places, but will the enemy attack them?—cannot apply to these iron networks, either already stretching over all civilized countries, or capable of easy development in the united interest of commerce and defense.

Necessarily and irresistibly the invader must be brought in physical contact with railway lines or abandon his invasion; and if brought in contact, he must advance and bring himself within the fire of batteries on them.

Sect. 84. The agglomeration of men, horses, and *matériel* which forms an army covers large areas of land.

Col. Colley gives as a rule that on a march one yard should be allowed to every two infantry soldiers, one yard for each horseman, and twenty yards for a gun.

Sir Garnet Wolseley estimates a column of march of an English division, with all regimental transport, as extending seven thousand yards, or about four miles. It is evident that no column of march of a considerable number of troops could pass in the range of the guns of railway batteries; that is, within a belt six miles wide on either side.

Sect. 85. It would become necessary, then, for an invading army, when approaching a fortified railway line, to arrest its march seven or eight miles at least from it, as a nearer approach would expose it to fire.

Improved lookout stations, mounted vedettes, and small outposts, field telegraphs, telephones, etc., would give the fortified road a reasonable indication of the enemy's movements.

The invader, finding himself confronted with a fortified railway which he must cross, or which he justly fears to leave in his rear, arrests his march, and prepares to attack in force.

There is a belt of land which can be made at least six miles broad, in which he must undergo artillery fire increasing in intensity and effect

as he draws near the line; and his problem is to advance through this belt of fire, reach the railway, and capture the batteries.

The capture of very large numbers of the batteries opposed to him is a *sine qua non*, for as these batteries command a belt of land six miles broad in their rear as well as in their front, it is impossible for the enemy, after attaining and crossing the road, to march across the opposite belt of land, if he receive a fire in the rear or flank. Therefore the enemy must capture these batteries or drive them to such a distance that the fire of batteries on the severed sections of road may not take him in flank or rear, and this distance must exceed six miles on each side, or twelve miles in all; for what possible advantage can it be for the invader to seize and hold one or two miles of the railway, when the batteries on either side must render it so difficult to debouch on the rear as to become practically impossible?

Consequently the invader must be able to capture and hold at least twelve or thirteen miles of the fortified railway, or must abandon his invasion.

Unlike any other fortified line, the vitality of the railway line is such that, without flank or rear, it suffers no collapse, exposes no flank, and loses as a whole no strength by being pierced; and each severed section, after fracture, is endowed with the same formidable power that it possessed before.

SECT. 86. The necessities of the enemy's situation being understood, let us consider some of the defensive resources of the fortified railway.

Accurate surveys previously made will enable each battery to be furnished with maps showing the contour of land in its front.

A band tinted in orange might indicate the two-mile belt of land beginning six miles and extending to a line four miles from the road, which orange belt would be swept by the fire of the long-range guns of the fortified line; another band, tinted in pink, might show the two-mile belt beginning four miles and ending two miles from the railway, which pink belt would be swept by the united fire of the guns of the first and second classes; and the third band, tinted in crimson, would designate the two-mile belt adjacent to the railway, commanded by the fire of all the artillery and machine-guns and the rifles of the supports.

Wherever covered ways, either through ravines or depressions or behind the slopes of hills, favor an enemy, shadowed lines upon the maps, through the colored belts, should indicate the course, extent, and width of such cover; and if the fire of guns at any point on the road for six miles, either to the right or left, would command the covered ways, dotted lines from the cover to the road would indicate the exact positions from which such command

might be obtained. If the contour of the land prevented the covered ways from being commanded from the railway, previous preparation ought to have caused the construction of a salient road, or earth-works, by which command of the approaches should have been obtained.

Sect. 87. Possibly, in many places, a direct fire may not be able to drive the enemy from the cover of a succession of hills adjacent to the road. Then the map ought necessarily to indicate the points on the railway from which vertical firing at a high angle should enable the plunging shell and case-shot to thoroughly sweep the partial cover.

The effect of vertical fire in sweeping the reverse of slopes is very considerable, especially when the contour of the ground is known.

Mortar fire illustrates this upon a large and effective scale, but the most satisfactory result obtained from vertical infantry fire is that noted in the "Report on Field Firing, India," in 1879.

Major Chatfield sums up the experiment as follows: —

> The reverse slope of a hill one hundred feet high, having a gradient of one foot in twelve, can be swept by the fire of Martini-Henry rifles at one thousand nine hundred yards, and troops placed under cover of such ground would be unsafe, even in extended order, lying down, at a distance of two thousand yards.

Salient lines at suitable intervals, like gigan-

tic lances, should start out from and when advisable return to the railway line; and between and in front of the salients other roads should enable skirmishers, behind the iron ramparts of wagons or of road locomotives, to advance resistlessly upon the unprotected infantry of the enemy.

Lofty lookout stations, made bullet-proof, on the railway batteries and on the adjoining hills would give extraordinary facilities for ascertaining the movements of the enemy, and might even serve for the use of Nordenfeldt, Gatling, or Maxim guns.

SECT. 88. We will assume that there had been provided a force to support the batteries upon a one-hundred-mile section of railway; and that this force consists, exclusive of the artillerists and of mounted vedettes, of eighty thousand men, or eight hundred men to a mile. Of these, three hundred men to a mile might be distributed in front of the batteries as pickets and skirmishers, and the remaining fifty thousand held in reserve in trains composed of bullet-proof wagons, distributed at suitable intervals along the line, and movable by armored locomotives.

If divided into fifty trains or more, no point on the whole line would be distant more than a mile from two battalions in reserve, which could be brought up or reinforced with all the speed that steam possesses; and as there would be in-

stantaneous communication with each train, the whole reserves or any portion of them could be brought with ease to desired points, with far greater rapidity than by a march on foot, even when placed in the rear of the assailed position, or of the skirmishers in front.

SECT. 89. We then have before us the consideration of what steps the invading army must take to cross the railway, and what resources the armed and fortified railway possesses to prevent the crossing.

The invader, finding that he cannot either leave the railway in his rear or march across it, which he is compelled to do if he push his campaign, finds himself forced to attack the fortified line.

The necessity of being forced to attack is a great disadvantage to the enemy. Heretofore, an invader, by threatening a vital line or position, could force the defending army to fight him on selected ground; but to meet the conditions of this system of railway defense, the invader is forced to assume the local offensive, and to attack positions carefully prepared and arranged for defense.

To accomplish this result has always been looked on by the masters of war as a most desirable object, and this policy has been reaffirmed by Von Moltke, the greatest captain the German race has produced since the great Frederick.

To force your enemy to attack you in a prepared and fortified position insures victory, unless you have failed in your duty to properly prepare and fortify your position.

What strategy can the invader develop if his only resource is to attack a position prepared to receive him?

When a place is once invested, the besieging force at once intrenches itself and prepares to receive the assault of the besieged, upon whom, whenever he wishes supplies, devolves the necessity of assuming the local offensive; and this very necessity makes his case hopeless.

An offensive strategy does not imply a local offensive, but its best results are obtained when it imposes that burden on the enemy.

Thus, when Von Moltke threw his forces across the road leading from Metz to Verdun, his strategy was offensive, but the local offensive rested with Bazaine, if he wished to escape from investment in Metz. When the Prussian Guard assumed the local offensive by attacking Canrobert at St. Privat, it lost six thousand men in ten minutes; and though the tactical formation of this attack was faulty and increased the loss, yet the whole experience of war is that the party taking the local offensive suffers most.

A German writer has carefully collated the losses of the French and Germans in each of the combats of their last war, and the results show, in a general way, that when the Ger-

mans took the local offensive, they suffered a loss of two to one; and that when the French assumed it, they suffered a loss of over three to one.

It is to be noted that in the war referred to the offensive was assumed most frequently against an enemy in the open field, only having the advantage of position arising from the natural features of the country, and that the difficulties and burdens of the ordinary offensive would be much increased in attacking railways properly fortified and defended.

It may be claimed that though the local offensive imposes generally a great loss on the party assuming it, yet the results obtained by it are often so decisive as to justify it. This is doubtless true, and though the improved arms of the present day have augmented the percentage of loss to be paid by attack, still the great advantages to be obtained from its intelligent use ought to be regarded as full compensation.

Thus, when the key position of a field can be carried by attack, it can be justified.

At Austerlitz the French attacked the Pratzen Heights, and carried them with loss, and this capture insured the victory; but no such formation as then used can be now adopted.

St. Hilaire advanced his division in company double columns, on the centre, and these columns deployed into line within a hundred yards of the enemy.

There can be no advantage in attacking any selected point of a railway fortified line, as there are no key positions to it; and if the selected point be captured, it can be held only at great risk, as the batteries on either flank remain as effective as if no capture had been made.

Again, it is justifiable to assume the local offensive in a battle when you can outflank your enemy. This, indeed, may be said to be the great object of modern tactics, and when accomplished is decisive. This is the great principle which gave the Germans the most of their successes against the French in the last war.

When General Grant extended his flank beyond General Lee's right at Petersburg, the surrender at Appomattox was almost a necessary result.

But this principle cannot apply to an attack on a fortified railway line which has no flank that an enemy can reach; or if it should have such a flank, then it is not fortified and defended in accordance with proper principles. The invader, then, is compelled to assume the local offensive against the railway line without any object in view such as ordinarily justifies this course.

If he seek to force a passage of this railway to prosecute his invasion, he must capture or drive away the batteries for a space of not less than twelve or thirteen miles, or otherwise his

columns of march will have to pass under the fire of artillery: and he has no choice but to make the attack, or to abandon the invasion.

Sect. 90. As before remarked, the principles that underlie the art of war are immutable, and never change; it is simply the method of the application, which varies with the changes of conditions and instrumentalities of war.

The principles that underlie the system of railway fortifications herein contended for are identical with those illustrated by Julius Cæsar, in the ablest exhibition of military science recorded in the annals of mankind.

Cæsar, with less than fifty thousand men, of whom large numbers were not Romans, marched against Alesia, a fortified town, which was covered by eighty thousand Gauls, under Vercingetorix, the ablest and most heroic general of his race.

The Gauls, taught by experience that they were incapable of successfully opposing in the open field the skill and courage of the Romans, took a strong position, their flanks covered by small streams, and their centre resting upon the impregnable hills of Alesia.

The position was too strong for even the courage of the Roman to attack; and Cæsar then determined to invest the town and the army which was compactly grouped around it.

He rapidly drew around the Gauls and the town lines of investment embracing eleven

miles in their circuit, and crossing both streams; and before Vercingetorix was aware of the object the lines were extended and sufficiently strengthened to resist attack.

Thus developing the most offensive policy, Cæsar forced the besieged to assume the local offensive. Leaving their strong position, the Gauls, sallying from the inner circle of siege, sought to break the larger circle of the investment, and failed after bloody assaults and repulses, exactly as the French failed in the last siege of Paris.

Cæsar continued to strengthen his lines, building block-houses at intervals on its weakest points.

When the Gauls realized that not only Alesia but their main army was besieged, then, far and wide, to the north and east, the people and tribes rose *en masse*, and formed an army of relief of 250,000 men, under chiefs accustomed to war and to fight the Romans.

But Cæsar was equal to the emergency. After strengthening his circle of investment so that the most desperate assaults of the eighty thousand besieged Gauls could not break through, he proceeded to draw outside of his troops a larger circle of fortifications, so as to enable him to resist the vast army of relief which was marching against him.

In preparing his outer line of defense, he exhausted the whole skill of the Roman engineers,

and left nothing undone which would enable him to defend his intrenched lines.

Within little over a month the relieving army of 250,000 men appeared, and surrounded and attacked him.

What a superb application of the science of war! By the most daring offensive strategy he was menacing the Gauls, and yet he imposed upon them the local offensive, and fought his army behind intrenchments on his front and rear.

Then followed a succession of desperate assaults, by day and by night, made simultaneously upon his front and rear, bloodily repulsed, until at last the vast army, which had come to relieve Vercingetorix and his eighty thousand men, dashed itself to pieces against Cæsar's inexpugnable lines, lost its *morale*, and was destroyed; while the invested army, starving and unable to break the lines of investment, surrendered.

The lesson from this magnificent feat of arms teaches us that the true principle of war is to force your enemy to assume the local offensive and to attack you, resting behind fortified lines, where small numbers of men can resist larger masses. It is this principle that I seek to utilize, when I advocate the preparation and defense of lines of fortifications so extensive that the enemy is compelled to assume the burden of the local offensive, and to attack carefully

prepared lines defended by mobilizable fortifications growing stronger during the progress of attack.

Sect. 91. After making his reconnoissance of the fortified railway, the enemy sends in his skirmishers along the whole front upon which he wishes to make a demonstration. The assumption is that the invader is in greatly superior numbers to the defender, and hence, if skirmishers contend with skirmishers alone, the invader will be successful.

But the railway defenders have not fortified a line for the purpose of delivering combat out of its protection, and hence their skirmishers retire until they reach a point where the enemy encounters the fire of the batteries on the salient roads, or of the bullet-proof wagons which are the effective skirmishers of the fortified line.

The skirmishers of attack must advance without artillery support, for it will be impossible to move artillery through the belts commanded by the artillery fire of the railway. Horses would perish under a fire that men may endure.

This artillery fire might be made effective to drive back the skirmishers, if desirable by reason of numbers or of the positions they might occupy ; but it assuredly must be used with sufficient effect to prevent the advance of any of the enemy's artillery within the range of their fire.

In addition to these aids the skirmishers of the railway lines, being first on the ground, and knowing that the enemy must attack them, would have the advantage of preparing selected positions from which they could annoy the enemy's advance.

SECT. 92. But the essential principle upon which this system of defense rests gives such an abnormal advantage to the defense that attack even of skirmishers becomes difficult. As the railway line has no flank, it follows not only that the enemy cannot outflank it, but that he himself must be outflanked in every movement he makes against it.

It has been assumed that about three hundred men would be allotted as skirmishers to each mile of the railway line, or thirty thousand in all for the one-hundred-mile section, while fifty thousand men would be held in reserve, as supports.

It follows, then, that wherever the enemy's skirmishers approach the railway line, they will not only be opposed in front, but will be outflanked to the right and left, not only by the skirmishers, but by the guns in the batteries of the railway; and it is not believed that any serious impression could be made against the flank, converging, and front fire of the railway defenders.

SECT. 93. But in railway lines properly prepared, it is evident that along their front at va-

rying intervals of six to eight miles apart there must be prepared salient positions, well advanced for a greater or less distance according to contour of land, which ought to be strongly held by batteries, machine-guns, and a small infantry support, while the rear and flank of such positions can be swept by the guns of the main fortified line.

These salient positions as long as held would break the continuity of attack, and would expose the enemy attempting to reach the main line to withering flank fires. In other words, the *ensemble* of the enemy's attack would be broken; and he must use fractions instead of masses.

If, in place of advancing to attack the main line, he undertakes to crush or destroy the salient positions, whose communications are open, whose flanks and rear are formidably protected by the main line, he must resort to regular siege operations, and fritter away his resources and the campaign.

It is self-evident that the mere skirmishers of the enemy could not hold any position between the salient and segmental roads upon which batteries could advance out from the railway line and intensify the capabilities of defense.

But if, at the worst, the enemy's skirmishers could make a lodgment on the railway, while it would be inconvenient, what would it effect?

The garrisons in the armored batteries would

be safe from harm, and their support could seek cover near to them, whilst approach or withdrawal would be equally dangerous to the enemy.

Nay, if the batteries withdrew a mile or two from the point of lodgment, the effect would be trivial.

Their communications would not be lost, and their guns would still command the lands on both sides of the railway, and could destroy any large body of the enemy or any trains undertaking to advance, and the hostile skirmishers could not well tear up the rails of the track, even if they crossed it within eight hundred or a thousand yards of the guns of the defending batteries.

Such lodgment only could be made at some particular point where a contour of ground would afford a shelter from fire; but it would be easy, if it were desirable, to dislodge the attacking force by overwhelming fire of guns, or men concentrated on either flank, already hemmed in by salient roads traveled over by formidable batteries.

If the enemy undertook to send to the attack any considerable number of men, how could they ever endure the withering front and converging fire of guns that could sweep with shell and shrapnel every rood of land in front of the railway line?

SECT. 94. The attacking army could not af-

ford to trust its fortunes to the movements of a few skirmishers, who might be destroyed whenever the batteries expended sufficient ammunition; and hence it must make a serious effort to sever the iron chain that holds it in check.

The enemy must prepare batteries and place in them the heaviest guns procurable. Whatever may be the range of his guns, if the railways are not armed with guns of greater range, the conditions imposed by the adoption of a system of defense based on their fortification have not been complied with.

It is to be considered that the enemy must operate without the aid of railways, unless he builds them as he advances, and that he can only use guns of such weight as he can conveniently transport; but the trains to transport these guns and their ammunition are very expensive.

The Germans brought two hundred and fifty siege pieces to take part in the bombardment of Paris and its detached forts. To be serviceable, these guns required platforms and ammunition sufficient for five hundred rounds per piece. Land transportation had to be relied on from Nanteuil to Villacoublay, where the park was to be found — a distance of forty-four miles — and wagons expended eight days in a round trip, laden one way only; and greater time when the roads were bad. To transport the guns, platforms, and ammunition, five thousand loads were necessary.

In addition to this, it became necessary to make provision for hauling the ammunition from the park to the batteries, and for bringing up ammunition to replace that expended. The German staff estimated that for the latter purposes alone 1,750 vehicles would be needed, and they were supplied by the organization of 24 siege park trains, each of forty 4-horse wagons, making 960 wagons, and the remaining 790 wagons were obtained in France. It may reasonably be estimated that 10,000 horses required two months to transport 250 siege-guns, with their platforms and ammunition, a distance of 44 miles, and to put them in position.

At the end of the year 1870, the Germans had in position 275 siege-pieces available for attack. The heaviest of these were 70 long guns of 24 centimetres, each weighing 2,500 kilogrammes, and their carriages and equipments as much more; 6 rifled mortars, cal. 21 centimetres, weighing each 3,200 kilogrammes, and its carriage 3,750 kilogrammes. The range of 24s was 8,000 paces, so that it would be necessary for the railway batteries to have guns exceeding this range, as experience has shown that guns of this calibre can be conveniently transported by land.

Sect. 95. When an army would prepare to attack a fortified railway line, it would be necessary for its heavy artillery and park trains, extending miles, to enter into the orange-col-

ored belt of land swept by the long-range guns of the railway. If these latter guns were well served and sufficiently numerous, it ought to be impracticable to bring within range such large and cumbrous trains, dragged by many horses, and compelled to confine themselves to the hard public roads or to new roads, to be built for them by the enemy while under fire. The perfect knowledge that the defending artillery would have of the ground over which the enemy must pass and of the roads on which he must bring his artillery would render it easy to hurl simultaneously, if need be, along the whole orange belt, huge shells, each capable of sweeping an area of fifty square acres, and fired from guns so divergent in position that concentrated, cross, and flank fires would intensify their effect, and could not fail to strike a target as extended and broad as the march of artillery and its parks. Assuming as the result of much sacrifice and labor that the invader succeeds in getting siege-guns into positions from which their fire may attain the road, yet comparatively how few in number and how limited in range of fire are his guns! His guns being less in calibre and range than those of the railway are necessarily sufficiently near or well advanced in the orange belt to be exposed to a fire that can command the communications to his rear, while it searches his front and each flank, and hence the enemy must protect his guns by

earthworks and traverses; or in other words, must assume a permanent position behind permanent works.

It is difficult to see how a position like this would be effective, for if, under the fire of these guns, he launches his infantry, it must encounter the fire of the railway batteries, which, if the enemy's fire should prove too heavy, have the privilege of shifting their positions behind cuttings or hills, which serve as traverses or ramparts from which they can sally to fire on the advancing infantry.

It is to be noted that after he discloses his intention it will require more than an hour for the enemy to march his infantry across the artillery-swept belts, four to six miles broad, before he can reach the railway, and within that hour it is within the resources of the railway defense to concentrate not only an increased number of batteries so as to make almost a continuous line of fortifications, but an increased force of infantry to assist by flank and front fire in repelling any attack having endurance and *élan* sufficient to approach the road. Before the attacking infantry can reach the road or fortified line, it must not only endure artillery fire in its front and flanks, but when it gains the salient and segmental roads it must encounter the bullet-proof batteries moving in completest security through its attacking lines.

SECT. 96. But no defensive position can be

regarded as perfect unless it offers an opportunity to take the offensive; and the railway defense develops that opportunity under the most favorable conditions.

As the attacking enemy must be necessarily outflanked, it will only be for the railway defense to accumulate a force on a flank, and thus, in the very crisis of the attack, to turn the flank of the attacking lines on one or both sides. The salient road and positions fringing the main line enable the batteries to take positions one or more miles in advance, and thus to enfilade the flanks of the attacking line.

No system of railway defense can be effective that does not provide the means for rapidly laying rails on which armored and unarmored batteries may pass at a fair rate of speed; and these means can be secured by construction trains carrying rails and a special corps to lay them; and the batteries themselves could carry a considerable portion of material.

Hence, whenever the railway defense desired to assume the offensive, temporary tracks could be laid approaching the enemy's line, whereby the armored and unarmored batteries would be enabled to advance at a distance from the road and effect decisive movements.

The facts that the railways are in possession of the defenders before the approach of the invader, and that the invader must necessarily attack, afford every opportunity to prepare in

advance numbers of salient roads, sufficient almost to paralyze invasion. A neglect to do this could only be imputed to folly.

In many directions these salients could be projected in such a manner as to force attack, or to give opportunity for operations on the rear of an enemy who would march past them.

In other words, skill and study should so develop the opportunities offered by the ability to use on rails mobile batteries or fortifications as to extract from the peculiarities of the ground to be defended the development of a defense embracing many successive lines and salient positions, which ought to prove absolutely free from the possibility of capture.

SECT. 97. It may be said that the enemy would avail himself of a night attack, and that he would thereby escape the danger of artillery fire, which to be effective must be accurate.

The defensive preparations would be bad and criminal that had failed to provide calcium and electric lights, fire-balls, and all other known aids to render a night attack difficult, if not impossible; and as the enemy at nightfall must be several miles distant from the road, it would seem that his advance could be discovered in time to make proper provision to receive and defeat it.

When, under the present system of war, an intrenched line is carried by an assault, a decisive result is achieved, as the whole line becomes

untenable; but this could not be the case with the railway.

Each railway battery has its separate vitality, not susceptible of serious injury by the capture of the adjoining batteries; and a proper construction of those batteries which may be armored would make it simply impossible for them to be carried by the attack or escalade of infantry, in whatever numbers it might be made.

There are many other reasons that must occur, upon reflection, to render it a most rash act to undertake to carry a properly prepared and fortified railway line by a night attack.

SECT. 98. It is difficult to foresee what would be the course of an enemy encountering the barriers of a fortified railway line; but if the line be properly prepared and armed, it may be said with confidence that whatever method of attack be adopted must fail.

In its presence all the known methods of tactics are inapplicable; it is a fortified line, and yet it cannot be invested, nor even assaulted with any chance of success.

It is true it might be besieged, — that parallels might be opened against it; but if this be done, then all the conditions of modern war are changed; and if this prove the only method of attack, it follows that, as railway lines can be constructed behind each track which may be approached by parallel and sap, every foot of the invaded country must be dug up and carried by regular approaches and siege.

It may be asserted that the country that defends itself by the fortification and preparation of railway lines is invulnerable to an attack made according to the present system of war.

The number of men of the attacking army, their discipline and armament, can make less impression upon the defense than the assault of the courageous Arabs of the Nile upon the steady British squares. No other means of attack can be available except to adopt the same material agencies for attack as for defense.

The assailant must construct railroads for attack; he must transport his guns and men upon rails and protect them as the defense does.

Instead of war being a butchery entirely of men, it will be a Titanic contest between railroad-builders and mechanical appliances; and the superior advantage of the defense will render attack, even under these conditions, still too feeble and expensive to give even a promise of success.

It is believed that the speculations and theoretical advantages claimed for a defensive system based upon the proper strengthening and fortifying of railway lines will be found far inferior to those to be realized by practical study and test.

SECT. 99. This system is not only available

for defense, but it will irresistibly augment the force of attack in the hands of an army organized and equipped to apply it aggressively against a people that has neglected to avail itself, by timely preparation, of the invulnerable protection to be found in a defense based upon principles which necessarily make the aggressive inferior to the defensive.

SECT. 100. If, on better and further examination, it should appear that this system possesses the capabilities claimed for it, a great amelioration of the condition of humanity can be effected. Large standing armies, with conscription and heavy taxation, and their attendants, poverty and immorality, can be dispensed with by all governments that have not some aggressive policy to carry out. Peace can rest secure behind iron ramparts, constructed by itself for commerce; and wars of invasion must cease in Christian countries, and be only pursued among peoples too savage or too ignorant to construct the iron highways of civilization.

SECT. 101. The comparative cheapness of this system must commend it. The use of draught-horses will be diminished eighty per cent., of artillery-horses ninety per cent. and of cavalry sixty per cent., and of men beyond computation. The guns and batteries, when prepared, could be kept in *dépôt* and the auxiliary roads necessary to strengthen the commercial roads could be used for trade and traffic.

The segmental and salient roads would only be laid after mobilization. The troops to man the fortified lines could be left at home, and only exercised at times so as to familiarize themselves with the management of railways, and with the method of handling the batteries and of building salient and other roads.

A few battalions of regular artillery only would be required to keep pace with the improvements of the day and to thoroughly master the practice of the system of railway defenses, and to give steadiness and skill to the raw levies, when called into service.

In a word, the military budget of nations not intending to wage aggressive wars could be reduced more than one half, and yet the country be protected beyond hazard of attack.

APPENDIX.

SUGGESTIONS SUBMITTED TO THE UNITED STATES BOARD ON FORTIFICATIONS OR OTHER DEFENSES.

Our defenses should be constructed so as to resist the maximum resources of possible attack.

We have nothing capable of resisting 25-ton and 30-ton guns, while our safety demands that we should be able to cope with the 100-ton guns of Italy, the 110-ton guns of Great Britain, and the projected 120-ton gun of Krupp.

We cannot rely on the private workshops of our own citizens or even of foreigners to make the many heavy guns necessary to protect our extensive seaboard fronting on the Atlantic, the Gulf, and the Pacific, and on the great Northern Lakes.

No other nation in the world has so extensive, so exposed, and so rich a coast to defend, and yet the increased resources of attack have made every fort and every gun we own absolutely useless.

The American flag, on land or sea, floats over no gun adequate to protect itself from any serious attack made by any European power, or by Japan, China, Brazil, or Chili.

Thousands of millions of dollars of American property in cities, towns, factories, and on farms, and shipboard, lie exposed to attack and to greater or less destruction, if any one of twenty foreign governments should wish to war against us.

The German, the Spaniard, and the Chilian have insulted us with the reckless indifference of a strong man careless of the feelings of a weak one; and we owe to the considerate forbearance and statesmanship of France and Great Britain a consideration in regard to important interests that imposes obligations upon us not compatible with the dignity of a people claiming a position amongst the great powers of the world.

If our government, then, rise to the level of the requirements of its position, many millions will be appropriated to create great centres of manufacture, excelling Essen, Creuzot, and Woolwich.

These reflections are submitted in the belief that the government will provide suitable artillery to protect our seaboard; and the question to be considered is how best to utilize it for the common defense.

If we adopt the present system of fortifications, an enormous number of heavy guns will be required to defend our principal ports, cities, and rivers; while to properly equip and defend our whole coast-line their number will be so great that one might shrink from advising the government to undertake to provide them.

I am not prepared to say what may be the probable cost of heavy guns and the necessary plant to make them, but it will be so considerable that even one hundred of them will severely tax our national resources; and yet, if our principal cities are to be protected, many more than one thousand will be required; and in addition a new navy is to be equipped and armed.

The possibility of relying on torpedoes as a system of defense is not regarded as sufficiently established to justify a reliance on them alone. In fact, the

study, experiments, and experiences, of European governments have very nearly shown that a properly equipped fleet can be made reasonably secure from the attack of torpedoes. Therefore, in these suggestions, it is assumed that the principal seaboard defense will be made with heavy guns, and that torpedoes will be used as supplementary and auxiliary appliances.

The necessity which demands so large a number of heavy guns arises from the fact that the defense must be made able to cope with the heaviest marine gun, for the reason that the guns on an enemy's ships are mobile, and can be used in attacking any selected point upon our whole coast-line. Thus, the two 110-ton guns to be placed upon the British barbette ship Benbow, and which are the most formidable ever designed, may be used against any important point of our coast, while our guns are localized by being placed in fortifications, and only extend their influence to the range of their limited fields of fire.

Therefore, all localities worthy of protection and having deep water on their front must be equipped so as to encounter the largest guns of an enemy, even though he may possess only two or three.

I submit the following propositions : —

1st. That the present system of mounting guns in permanent works is faulty and defective for many reasons :

A. It enables the attacking ships-of-war, from divergent positions, to deliver at a fixed target a concentrated flank or front fire difficult to be borne.

B. While the permanent work is a fixed object for the enemy, its artillery must be fired at the isolated and moving targets of separate ships, endowed with great mobility ; and hence the chance of its guns

striking the mobile enemy is only one half of that of the enemy hitting it.

C. The influence of guns is localized to the range of their respective fields of fire by permanent works and the present system of mounting; and hence, if any enemy can steam past the range of their immovable fields of fire, the guns become useless, and the enemy, so running past them, can only be attacked by other permanent works, liable to be attacked and passed in the same manner.

D. It demands an excessive number of expensive guns and fortifications commanding each particular locality exposed to attack, and allows of no means of increasing the number of guns in the crisis of attack or of replacing them when dismounted by the enemy's fire.

2d. A system of mounting heavy guns can be adopted whereby they may be endowed with mobility, enabling concentration, and reënforcement in the crisis of attack, and pursuit in case the enemy should pass them; whereby the influence of each gun would be augmented so as to give it a field of fire along the whole front of the line upon which it may be moved; and whereby a smaller number would defend larger districts of territory.

No time will be consumed in dwelling upon the defects and inefficiency of the present system of permanent works and guns, as it has been demonstrated over and over.

But the enormous expense required by it to give adequate protection to our coast is worthy of consideration, and merits careful study to see whether a new system combining efficiency with economy cannot be devised.

To proceed in the old routine of defense is to deny

to the engineering department the use of the wonderful agencies and appliances placed at our command by science and the arts.

The military art is necessarily conservative, and the principles upon which it rests are immutable ; but the application of these principles varies with the discoveries of each age.

A change in military methods or weapons is pregnant with consequences involving victory or defeat to the country, and it is scarcely to be wondered at that the military authorities look with disfavor upon any theory or even facts that may tend to discredit systems of defense attested by actual war to be good and effective ; but this conservatism may produce painful and extraordinary results.

In the last century the rifle in the hands of our ancestors in many battles, and notably at King's Mountain, established its superiority over the smooth-bore muskets ; and yet the wars of the French Revolution and the Italian and Crimean wars were, with limited exceptions, fought with smooth-bore muskets. But, more extraordinary than this, we who had demonstrated the superiority of the rifle over the musket continued to arm our own soldiers with smooth-bores for the first half of this century.

The breech-loading needle-gun was condemned by the military authorities of every European government except the Prussian ; and, notwithstanding the practical use of this gun in the Schleswig-Holstein War, no European government undertook to adopt it until 1866, when the victory of Sadowa showed that the Prussians possessed the most formidable arm in the world. Therefore, in assailing the old system of mounting heavy guns and advocating the adoption of a new method whereby the discoveries of science can

be utilized for warlike as well as peaceful purposes, precedents in the history of military administration indicate that it is not always wise to disregard the discoveries and improvements of the age.

No one can deny that, if the heaviest guns adapted to defense can be made mobile without impairing their efficiency, such a result is desirable for very many conclusive reasons.

I claim that this mobility can be obtained by mounting the guns so that they may be moved upon lines of prepared railway, and that this will result in giving increased effectiveness at a diminished cost.

It may be objected:

1st. That guns cannot be transported and fired from rails under effective conditions.

2d. That in no practical way can satisfactory mobility be given to the guns.

3d. That if at great cost and risk the mobility of the guns be obtained, yet the heavy and unwieldy weight of the guns, of their carriages, and of their projectiles, the difficulty of rapidly and conveniently putting them into and withdrawing them from position, and the unsatisfactory method of mounting the guns to give them mobility, would render them less effective in actual combat than if mounted and fought according to the present system.

I. The mere transportation of heavy guns on ordinary commercial rails is a matter of frequent occurrence. There are many locomotives that weigh sixty to seventy tons; and their weight is vastly increased by the adhesion of their driving-wheels, dragging at high rates of speed trains weighing over two hundred and fifty tons, not only upon levels, but up high gradients. The Woolwich 80-ton guns and the 100-

ton Armstrong guns have been fired at experimental butts from iron rails.

There is no mechanical difficulty in transporting and firing from rails the heaviest artillery. But the actual test so far has only shown that the rails will allow the gun to be fired when it is parallel with them.

The effect of the recoil of heavy guns fired at an angle to the rails upon which they may be mounted can only be surmised, until further experience teaches us practically.

It may be that the recoil of a heavy gun fired at an angle to the rails upon which it is mounted will crush down or bend the rails; but possibly if the gun-carriage be supported upon seven or eight axles resting on fourteen or sixteen wheels, and if it be properly provided with powerful springs and submitted to great friction, no such effect of the recoil may be produced.

This is a matter for practical experiment; but if it be found that such a result will be produced, it can be remedied by increasing the weight of rails or their number or gauge, or by providing the additional support of screws or props, by which the pressure of recoil could be taken in whole or in part off of the rails.

But it seems probable that in practice, if this system be adopted, the guns will be more or less generally switched off the main track into prepared positions, and hence fired with a parallelism of the rails of the switch more or less complete; and hence it may be claimed that they would be used under the conditions under which heavy guns were fired from rails at the Woolwich, Essen, or Spezzia trial-butts.

It is probable that for the heaviest artillery the

weight of the rails and the gauge of the road may be required to be increased.

The ordinary gauge of commercial roads, about 4.7 feet, may not allow a sufficient stability for the gun-carriage of a 100-ton gun, though it may answer perhaps for a 25-ton gun; but, as railways would be specially built for coast defense and would be only short lines, the needed width of gauge may be obtained by laying an extra rail or a double track, or by widening a single track.

The question of the stability of a gun mounted on rails depends upon the length of the gun from the centre of its trunnion back to its breech-piece, or cascabel, and its point of preponderance.

The diameter of the turrets of some of the British ironclads is only from eight to nine feet, and large guns are mounted in pairs within these turrets.

The centre of gravity of a gun will be to the rear of the trunnions, and will have relation to the preponderance; and the gauge of commercial roads allows about five feet of solid bearing under the centre of preponderance of the gun to give it stability; but, if screws and artificial support be provided, the bearing under the centre of its weight might be extended to eight feet, a customary width of railway cars, sufficient to allow the handling of very large guns.

The capabilities of the railway system certainly admit of details insuring transport of the heaviest guns and their carriages and ammunition, stability of carriage, and endurance of the stress of recoil from fire.

II. This objection presents the question of the competency of a railroad to give efficient mobility to heavy artillery under the conditions of actual war.

The railroad and gun-carriage of the most approved pattern being built, it is essential that the guns be susceptible of a speedy and secure mobilization.

As railways of the character contended for will not be very extensive, only embracing the localities within the range of attack, mobility may be given by means of locomotive engines, or cables, or electricity.

A careful study, such as only a government can give, will devise the best method for producing the mobility of guns, so desirable for defense. It may be that different localities may require different motive power; but it may be confidently claimed that the guns can be readily moved by steam power applied directly, or by cable, or by electricity.

If careful and exact study can show that electricity can be successfully applied, that power is assuredly the best to be applied during actual combat, as it could be utilized, not only to move the guns, but to load and handle them. While this might be accomplished by steam, study must decide whether it would be more difficult and less simple than electricity.

While the want of special knowledge may prevent the recommendation of any particular system, yet the convenient and rapid movement of railway carriages by electricity has passed from theory into actual use.

The Berlin and other European electric roads, and the inventions of Edison, Daft, and others, offer great capabilities.

The Daft system, which has been practically demonstrated in this country, and which uses each rail or a copper wire as a conductor of power, seems very suitable. The low power transmitted prevents danger from contact, while it would be competent to sink into the ground, beyond the reach of the enemy's projectiles, a cable to transmit the power. Storage batteries might be utilized to furnish auxiliary power.

It results from the foregoing that ample motive power exists at the disposal of the engineer to satisfactorily move the heaviest guns on rail during the very crisis of attack and combat.

The mobility of guns out of the presence of the enemy may be conceded, and the same power may be utilized in his presence, unless his fire will prevent it.

Hence, satisfactory mobility implies reasonable immunity from the effect of the enemy's fire.

It will be an enormous advantage over the present system if guns can be mounted so as to be moved when out of the range of the enemy's fire, or at night.

Take the defense of the New England coast. How many guns and permanent works will, according to the present system, be required to make this rich shore-line safe from ships carrying guns of six or seven or eight miles' range? To protect Newport alone, how many guns and works will be required?

But if suitable positions be prepared along this whole line and connected by railways; and if guns be collected in groups at stated intervals along the coast-line, ready, when summoned by telegraph, to be hurried as fast as steam can travel to menaced points, what enormous advantages would result over the present system of the immovable localization of each heavy gun; and this capability of carrying artillery from points not in danger to menaced points would make it safe for the government to provide fewer heavy guns, and at the same time give it the power to concentrate in actual combat a larger number than can be hoped for from the present system of localization.

Even if the fire of the enemy would destroy the mobility of the heavy guns, yet the possession of that mobility out of the range of his fire, or by night,

is so important as to justify the substitution of their mobile mounting to the present immovable system.

The mobile guns could move with greater rapidity than the fastest iron-clad ship, and the telegraph and telephone could summon them into position before the ship-of-war could accomplish any injury.

But it is in no way conceded that a satisfactory mobility could not be obtained under the enemy's fire.

If the guns were moved along an open railway wholly exposed to the enemy's fire, the difficulty of the enemy striking an object moving at the rate of fifteen or twenty miles an hour is so great as to justify reliance upon its immunity from harm.

But such exposure would be only exceptional, and would only arise from a failure to properly develop the defensive resources at our command.

It is not unusual that hills and uneven ground abound in the locality to be defended. Then these hills and ravines constitute covered ways and traverses for the railway line, which will cross them at a low level, and through these cuttings favorable positions for fire may be found and utilized.

Ordinarily only limited distances will be subject to the fire of the enemy, and this exposure could be covered, either by sinking the railway at those points so as to afford cover, or by artificial embankments thrown up at selected intervals.

Under all conditions, when the railway line passes by points exposed to the enemy's fire, the rails should be sunken sufficiently to give them protection from fire.

But even if the railway be struck, and one or more sections be destroyed, how easy, with prepared *matériel* and trained men, to replace the injured sections when it is decided to move the batteries.

The various devices for working the road, and the capabilities of protecting the rails and the guns upon them, will be so manifested by careful study that no further time will be given to their elaboration.

But if, at the worst, the enemy's fire could impair or destroy during its actual continuance the mobility of the guns, yet that mobility would exist before he opened his fire, and would revive upon its cessation or during the darkness of night.

III. The practicability of firing heavy guns from a railway and of moving them upon it being assumed, it may be objected that they must still be fought from prepared positions as now, protected by heavy work forming adequate cover from the tremendous energy of attack; and that the heavy weight of the gun, its carriage and ammunition, would make its handling cumbersome and difficult, while necessarily the gun must be fought upon the carriage upon which it may be transported, which would be inconvenient and not as good as the carriage provided in a fixed and immovable work; and that these and other difficulties of detail would produce an inferior service in action.

It can be justly conceded that any system that can be proven to materially enfeeble a gun in the supreme and decisive hour of combat is defective and should be condemned, but the proof must be considered before the condemnation.

The proper method of mounting heavy guns to be moved and fought from a railway is theoretical, except so far as the experiments at the European trial-butts have shown that it is practicable.

The proper form of a gun-carriage for mobile heavy guns will be influenced by the questiou whether they are to be fought *en barbette* or from a casemate.

If it be considered better to prepare covered positions similar to those now most approved, the heavy guns could be carried into position by means of switches, and fought under precisely the same conditions as if permanently localized, as at present.

It would undoubtedly be prudent to prepare the strongest casemated positions in a few exceptional localities, such as an island or a projecting point of land close to which ships must inevitably pass; but it seems that ordinarily it would be better to fight the guns *en barbette*, with such protection as may be derived from sinking the rails below the surface or from cuts or from artificially prepared embankments and slopes made at suitable intervals. In addition to protections like these, the guns would necessarily be capable of being fired at separate intervals, and not grouped close together, as when casemated or protected by heavy works.

This grouping of guns under the present system is injurious in two important directions.

It causes the guns to have only limited fields of fire, which are liable to be obscured by the smoke of neighboring guns, which smoke affords protection to the enemy.

And secondly, the fact of the guns being immovable and close together confers upon the enemy the ability to get the exact range for aim and fuse cutting.

These two causes enfeeble the defense and intensify the power of attack.

If the guns be fought *en barbette*, separated at intervals, the smoke of one gun will not obscure the aim of the others, while no concentration of the enemy's fire can be made so as to involve all of the defending guns; and whenever a concentration of fire

against one or more of them is manifested, or whenever it is evident that the enemy has attained a good range, then their mobility will allow a shifting of position either to right or left or behind cover.

The effect of the fire of twenty guns occupying divergent positions intensifies their converging fire with an energy exceeding that of fifty guns grouped together in closed and permanent works, according to the present system.

This ability to engage the enemy's ship along an extended line affords the means of rendering torpedo defense more effective, as the torpedoes would be prepared for operation only after the enemy had well advanced into the field of fire of the defending guns.

Hence, the counter torpedo attacks, as developed by European experience, would be so enfeebled under front and flank fire as to give to the torpedoes a better opportunity to operate.

It is believed that guns could be fired from heavy rails at a right or other angle; and hence, while positions with switches might be prepared, yet in actual combat the guns, when necessary, could be discharged from the rails of the main track itself.

These railway lines, when properly prepared and equipped, could be utilized for the transport of troops and lighter guns in case the enemy should undertake to make a landing.

The ability to make carriages adapted to barbette or casemate service will offer no difficulties to the ordnance service, and these carriages can be provided with contrivances and power whereby loading and aiming can be done mechanically.

A system of mobile guns affords us the means, at a moderate expense, of defending long stretches of our seaboard.

Guns could be prepared and stored at convenient and central localities commanding the thousands of miles of water-lines to be defended, and, in case of necessity, moved by steam and rail to carefully prepared defensive positions.

Especially can this system of mobile guns be applied to the defense of the Mississippi and other rivers.

In considering a proper system of defense, due influence should be given not only to the heavy guns of attack, but to the capability of an iron-clad ship to steam at the rate of eighteen or twenty miles an hour past the range of the guns of a fort, while submitting to the chance of not being injured by its fire.

The present system of localized guns can make no provision to remedy this contingency; while, if the guns be mounted so as to be mobile, they could pursue the enemy and renew the combat.

The ability to fire upon an enemy at any point when he would come within range of mobile guns mounted on a line of railway would prevent the enemy from possessing the exact knowledge of locality which the present system of fixed guns affords him.

Before taking his position the enemy now knows the exact situation and range of each gun which he has to encounter; while if mobile guns were used he would be deprived of the enormous advantage resulting from this knowledge.

Where the railway presents many points from which guns could reach an enemy's ship, some of these points could remain unoccupied until the enemy had steamed past them; and then, while the fire of guns at other points would arrest the movements of the hip, guns could be moved into positions which woulds command the line of withdrawal or retreat and afford opportunity for flank fire in the crisis of fight.

The mobility of the guns would enable the artillerist to realize in its perfection his cardinal principles of divergent position and concentration of fire.

It may be that the fertility of American invention will soon disclose agencies by which lighter guns, using either as a charge or in a shell dynamite or other explosives more powerful than gunpowder, may be enabled to successfully engage the heaviest artillery of ironclads; but in this case the mobility of such guns would be as valuable as that of heavier guns, while it could be more readily attained.

If Congress will vote the necessary millions to establish great ordnance plants, there is but little doubt that American genius will place at our disposal resources of defense far beyond what we at present can even surmise. Respectfully submitted,

JOSEPH L. BRENT.

ASHLAND, NEW RIVER, LOUISIANA,
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